MODEL D325

15

LOWREY®

SERVICE MANUAL

Holiday

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MODEL D325

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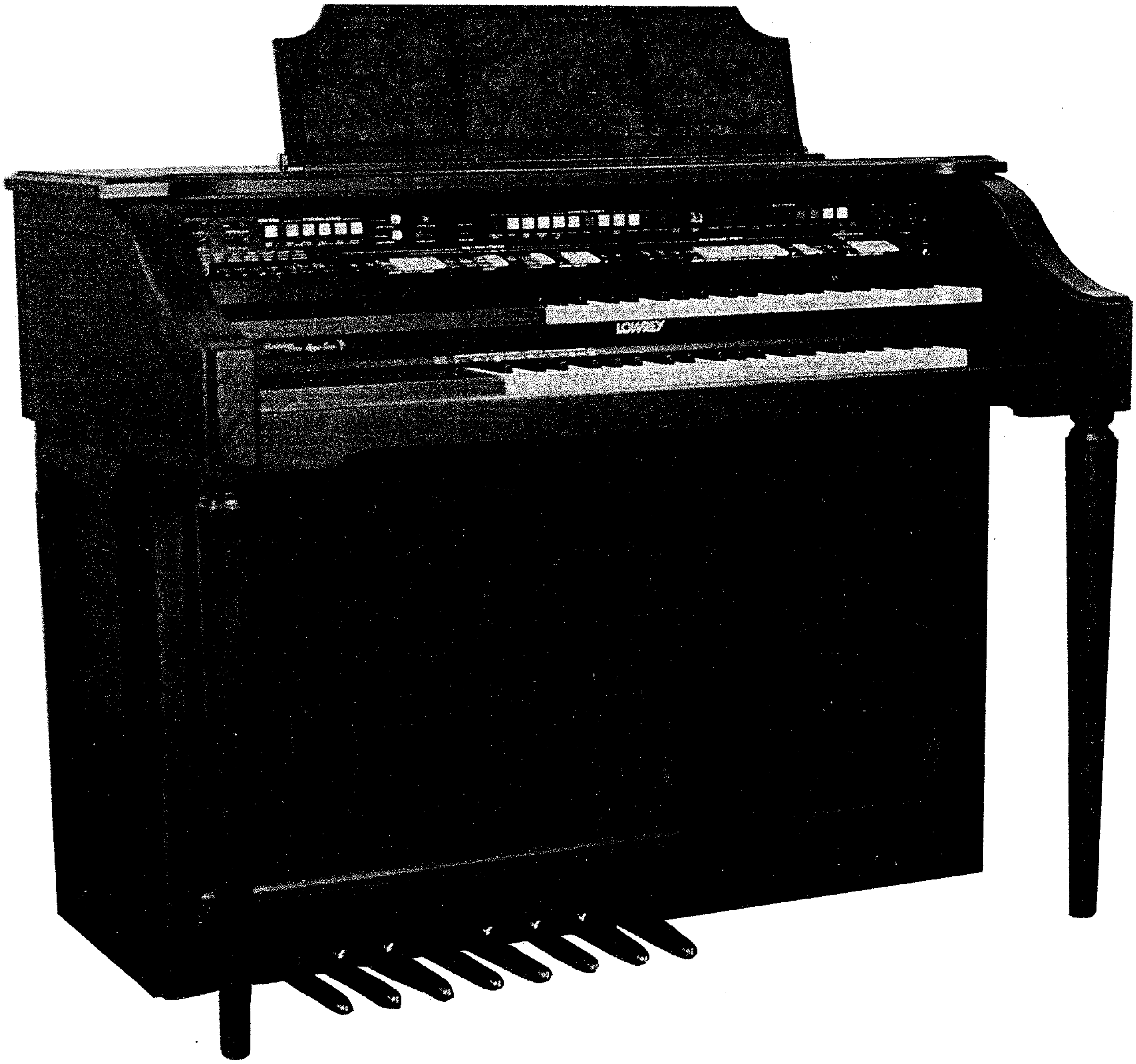
SPECIFICATIONS



SPECIFICATIONS

LOWREY HOLIDAY (Model D325)

The Holiday is a self-contained spinet organ with two 44-note keyboards and a 13-note pedal keyboard. The organ is solid state (large scale integrated circuit and transistor). Five amplifiers drive five separate speaker channels.

UPPER KEYBOARD

Tabs

Trombone 16
Clarinet 16
Cornet 16
Kinura 8
Flute 16
Flute 8
Flute 4
Flute 2-2/3
Flute 2
Flute 1

Symphonic Strings

Violina
Viola
Cello

Orchestral Presets

Activated one at a time except Symphonic Wow which is independent of the other Orchestral Presets.

Symphonic Wow
Vibes
Vibra Harp
Harmonic Flute 4*
Harmonic Flute 2-2/3*
Piccolo
Piano
Violin
Harpsichord
Mandolin*
Banjo*
Accordion
Hawaiian Guitar

* These Orchestral Presets will repeat when the Repeat tab is pressed.

Solo Presets

Activated one at a time, keyed monophonically.

Trombone
Trumpet
Clarinet
Saxophone
Bassoon
Oboe
Piano
Clavecin
Guitar
Jazz Flute

Upper Keyboard Effects

Repeat - adds repeat effect to Banjo, Mandolin Harmonic 4 and 2-2/3 Orchestral Presets

UPPER KEYBOARD

Upper Keyboard Effects (Continued)

AOC - adds one-finger right hand chords to upper keyboard tab and Orchestral Presets (except 2-2/3)

Vibrato - affects all voices except Solo Presets

Upper Keyboard Controls

Sustain Control - adds sustain to upper keyboard diode keyed voices

Wow Range Control
Wow Attack Control
String Volume Control
Cancel Upper Button - cancels upper keyboard tabs or tabs and Orchestral Presets

Solo Presets Controls

Solo Volume
Solo Tuning
Solo Vibrato Speed
Solo Vibrato Depth

LOWER KEYBOARD

Tabs

Piano
Guitar
Banjo
Flute 8
Flute 4

Symphonic Strings

Violina
Viola

Magic Melody

Plays accompaniment counter-melody with selected rhythm (Rhythm 6 has highest priority). May be keyed from bass pedals or lower keyboard when Magic Chord tab is on.

Piano
Strings
Banjo

Magic Genie Chords

Magic Genie Chord tab - enables Magic Genie
A2 Keyswitch - adds seventh to Magic Chord (A2 key will not sound if pressed alone)

SPECIFICATIONS

LOWER KEYBOARD

Magic Genie Chords (Continued)

Minor Footswitch - changes major chord to a minor

A2 Key and Minor Footswitch changes Magic Chord to a minor seventh

Key Note	Gives this Magic Genie Chord
A1	A Major
A#1	A#/B_b Major
B1	B Major
C1	C Major
C#1	C#/D_b Major
D1	D Major
D#1	D#/E_b Major
E1	E Major
F1	F Major
F#1	F#/G_b Major
G1	G Major
G#1	G#/A_b Major

Lower Keyboard Controls

Lower Medium tab
Lower Full tab
String Volume Control
Magic Melody Volume Control

BASS

Pedal 16-8

Guitar Bass - adds guitar sound to pedal bass. When used with the Genie String Bass or Magic Swing Bass tabs adds guitar bass to these voices

Genie String Bass - enables keyboard bass

Magic Swing Bass - enables Magic Swing Bass when used with rhythm. Plays one of 18 different patterns depending on selected rhythm (Rhythm 6 has highest priority). Keyed from Bass Pedals or from keyboard when Magic Chord tab is on.

Bass Control Tabs

Bass Medium
Bass Full
Pedal Sustain

STEREOPHASE SOUND

Main Chorus
Main Celeste
Flute Chorus
Flute-String Celeste
Leslie Tremolo Flute

TRACK III STEREO RHYTHM

Ballad
Dixie
Swing
Country
Swing Waltz
Waltz
Tango
Samba
Bosa Nova
Rhumba
Cha-Cha
Latin Rock
Rock
Hard Rock
Soft Rock
Disco
March
Metronome

Rhythm Controls

Rhythm Speed - also controls Repeat speed

Rhythm Volume

Rhythm Balance - full left=drum; full right=brush

Downbeat - Intro/Break - flashes at downbeat
Pressing Button enables Intro pattern

Rhythm Auto Start - starts rhythm automatically when lower keyswitch or Bass Pedal is pressed. Stops automatically when all keys or pedal released.

GENERAL FEATURES

Reverb Length Control

Power On/Off

Photoelectric Expression Pedal

Glide/Sustain footswitch (Left side of expression pedal)

Auxiliary Input/Output Jacks (under organ, below lower right endblock) - for recording device

NOTE: A microphone will require an external preamp (not available from Lowrey)

Leslie Tone Cabinet Output Socket (on Power Supply Chassis)

Headphone Jack (accepts stereo or mono headphone)

DIMENSIONS

Height	40"
Width	48"
Depth	28"
Weight	275 lbs.

CIRCUIT DESCRIPTION

OVERVIEW

The Lowrey Holiday (Model D325) incorporates four high frequency oscillator/synthesizer circuits to generate audio frequencies. The Tone Generator (Schematic 1) provides the upper and lower keyboard diode keyed tones. A phase-locked Loop and Divider generate the tones for the Magic Melody and Swing Bass (see Schematic 12). The Chord Function Generator and Pedal Bass frequencies are generated using a common oscillator (see Schematic 15). The Solo Presets have their own oscillator (see Schematic 15).

Three types of keying are used in this instrument. Diode keying is used for the upper and lower keyboard voices except the 2-2/3 Flute (see Schematics 2 and 3). The 2-2/3 Flute is audio keyed (see Schematic 5). A keyboard scanning system is used for the upper keyboard solo voices and for the lower keyboard Magic Genie Chords and Keyboard Bass (see Schematic 15).

The AOC feature (see Schematic 4) may be keyed from either of two sources. With the Magic Chord tab off, AOC information is applied to the AOC Drivers from the lower keyboard diode keying (see Schematic 3). When the Magic Chord tab is on, serial data is decoded into AOC information which is applied to the AOC Drivers (see Schematic 15).

NOTE: The Flute 2-2/3, Harmonic 2-2/3 and Solo Presets do not have an AOC effect.

Two circuits are used for Chorus. A single phase chorus (Schematic 7) is used for the Reed voices. A three phase chorus circuit is used to modulate the Symphonic String and Flute voices (see Schematic 9).

Active, passive and voltage controlled filters are used to develop the tonality of the organ voices. The Flute filters are non-inverting, three pole active low pass filters (see Schematic 5). The String filters are passive filters (see Schematic 6). The filters used for the Reed/String Quality Control are non-inverting, active band-pass filters (see Schematic 8). The Magic Melody and Bass filters (see Schematics 13 and 14) are also active filters. Digital pulse codes are converted to analog voltage levels which tune voltage controlled filters to pass a band of frequencies dependent on the Solo note that is keyed (see Schematic 16).

The Lighted Button Presets (Orchestral Symphonizer and Solo) are activated one at a time (see Schematic 10). The Lighted Buttons for the Symphonic Strings and Symphonic Wow may be activated or cancelled in any combination. Any combination of upper keyboard tabs (including Symphonic Strings and Symphonic Wow) and/or an Orchestral Preset and/or a Solo Preset may be used together. If the Cancel Upper Button is pressed, the Orchestral Preset (including Symphonic Wow) will override the upper tabs and only the Orchestral Preset will be heard. The Solo Preset will override both the upper tabs and the Orchestral Presets.

Exceptions:

1. The Symphonic Wow will cancel when a Solo Preset is activated along with the Cancel Upper Button.
2. The Harmonic 2-2/3 Preset will not cancel.
3. The AOC will play the selected Orchestral Symphonizer Preset when this feature is used with the Cancel Upper.
4. If a Solo Preset is selected, the AOC will play on both the upper keyboard tabs and the Orchestral Symphonizer preset.

The Clock Multivibrator (see Schematic 11) provides clock pulses to drive the Repeat Modulator and the Rhythm Function Generator. The Rhythm Function Generator (RFG) is the source of all triggering pulses for the rhythm instrumentation, Genie and alternating bass. Serial data encoded with rhythm time point information is outputted from Pin 7 of the RFG. This data along with rhythm tab data is inputted to the Magic Melody and Swing Bass Read Only Memories (ROM). (See Schematic 12.)

Each rhythm time point causes the outputs of the ROM's to change. The output levels determine which notes of the Magic Melody and Swing Bass will be heard.

Audio signal from a selected bass pedal or Magic Chord (depending on the position of the Magic Chord tab) is applied to the reference input of a phase-locked loop (see Schematic 12). The comparator input is from a frequency divider. If the comparator input frequency is different from the reference frequency, a voltage is outputted from an internal voltage controlled oscillator (VCO) until the comparator input frequency is the same (in both frequency and phase) as the reference frequency.

The Divider (see Schematic 12) produces an octave of audio pitches where the root pitch is equal to the reference pitch. The pitches that are harmonically related (root, 3rd, minor 3rd, 5th, 6th, 7th, octave [8th]) are routed to the Magic Melody Keying circuits (see Schematic 14). Keying pulses from ROM 1 apply the audio signal (or audio signal divided-by-two) through a mixer to the Magic Melody filters where the tonality is developed. The audio is then amplified and applied to the output mixer. The outputs of the Divider are applied to the Swing Bass Note Select IC9. The Swing Bass output is determined by a three bit address code applied to IC9 from ROM 2. The Swing Bass audio is divided and applied to the Bass Filters (see Schematic 14).

Depending on the position of the Swing Bass tab, either pedal or Swing Bass audio is keyed and applied to the Bass filters where the bass tonality is developed (see Schematic 14).

The scan time points for the Upper Keyboard Solo and Lower Keyboard Magic Genie keyswitches is developed by the Chord Function Generator. (See Schematic 15.)

The CFG/Pedal Oscillator (IC17) applies 500KHz to the Pedal Latch. The Pedal Latch outputs an audio frequency corresponding to the bass pedal being played. The lowest pedal pressed has priority. The pedal audio is routed to the Phase-locked Loop (see Schematic 12) where it provides the reference for the Magic Melody and Swing Bass (depending on the position of the Magic Chord tab) and to the Pedal Dividers (see Schematic 12).

The CFG/Pedal Oscillator frequency is divided in half and applied to the Chord Function Generator. Audio outputs from the CFG provide Magic Chord, High/Low (Root/Fifth) bass and Magic Melody reference signals. The 4-foot Magic Genie and Magic Genie AOC are decoded from serial data outputted from the CFG.

The Solo Generator Oscillator (IC26) provides a frequency of 1.26 Megahertz to the Solo Generator. The Solo Generator is a priority note generator which outputs only one audio frequency corresponding to the serial data from the highest keyboard note that is played.

A pulse code is outputted from the Solo Generator which tunes voltage controlled filters (see Schematic 16) to the octave containing the note being keyed. The voltage controlled filters are used for the Guitar and Jazz Flute Solo presets.

The audio outputs of the preamps are mixed together then routed to any of four volume regulators (see Schematic 17). The output from the volume regulators is applied to the crossover filters (see Schematic 19). The low frequency audio is routed to the bass amplifier via the bass low pass filter. A total of five power amplifiers are used in this instrument.

SCHEMATIC 1

TONE GENERATOR

TONE GENERATION

The Master Oscillator IC14 generates a 2 Megahertz (MHz) waveform which is applied to the Top Octave Synthesizer (T.O.S.) IC13. The T.O.S. is a divider. Each output changes state after counting a predetermined number of clock pulses from the master oscillator. The square waves outputted by the T.O.S. are the thirteen highest audio frequencies of the upper keyboard. The T.O.S. frequencies are applied to IC1-12. Each frequency is divided in half to produce a pitch one octave below the T.O.S. The divided output frequency is divided again to produce a lower octave pitch. This method of frequency division provides all keyboard pitches except Magic Melody and Swing Bass, Chord Function Generator and Bass Pedal, and Solo Preset voices.

Diode D1 rectifies the T.O.S. Master Oscillator frequency into a negative DC voltage when measured with a voltmeter. The vibrato signal modulates this voltage which in turn varies the amount of feedback in the tank circuit. This causes the Master Oscillator frequency to fluctuate at the rate of the Vibrato oscillator.

Pressing the glide switch applies a positive voltage to a 20K resistor, which causes the voltage at the anode of D1 to become less negative. This reduces the feedback of the tank circuit causing the T.O.S. Master Oscillator frequency to shift.

SCHEMATIC 2

UPPER DIODE KEYING AND DC CONTROL

UPPER DIODE KEYING

Pressing an upper keyboard keyswitch forward biases the keying diodes associated with that key. The audio signals are applied in groups to filters where wave shaping occurs.

SUSTAIN

Each time an upper keyboard keyswitch is pressed, a 47ufd capacitor associated with that key is charged. At key release, the capacitor discharges through a discharge switcher transistor and a diode to a negative voltage potential. If a positive voltage is applied to the base of Q18 by the Sustain Length Control or a preset voice which uses the sustain effect, Q18 and Q28 will be partially-to-completely biased off. This causes the voltage at the base of Q112 to become less negative which biases off Q112.

The bases of the discharge switchers become less negative which partially biases the discharge switchers off. This slows the discharge rate of the capacitor which keeps the keying diodes forward biased for a short time after key release, giving the sustain effect. As the voltage on the base of Q18 becomes more positive, the sustain length increases.

IC2C, IC2D, Q19 SUSTAIN CANCEL TRIGGER, SWITCHER

The Orchestral Preset voices use a monophonic sustain effect. Each time an upper keyswitch is pressed, the sustain for the previously played note is cancelled. Selecting any lighted Orchestral Preset (except Symphonic Wow) will enable the sustain cancel trigger by applying a low to IC2D Pin 13. When any upper keys are pressed, a steady positive voltage is applied to IC2C Pin 8. Pin 10 switches low. IC2D momentarily senses this low through the .22ufd capacitor which causes its output to switch high for the duration of the pulse. This positive pulse causes Q19 to saturate which momentarily grounds any positive voltage applied to the sustain length regulator Q18. Q28 saturates, instantly discharging the sustain capacitors to the negative voltage at the emitter of Q28.

SYMPHONIC WOW

Selecting the Symphonic Wow preset applies positive voltage from the Symphonic Wow Latch to the cathode of Diode D12, reverse biasing the diode. At keydown, a positive pulse is applied to the Keydown Reset Q15. Q15 is momentarily saturated. This insures that the .15ufd capacitor at the base of Q14 is discharged. The keydown causes the following sequence to occur:

1) The keydown pulse "sets" IC2A Pin 3 high.
2) This high level is applied through the Ramp Driver and charges the .15ufd capacitor at the base of Q14. This causes Q14 to gradually turn on, which turns on Q13.
3) The increasing ramp voltage "opens" a voltage-controlled filter which passes higher harmonics as the control voltage becomes more positive. This causes the "wa" part of the effect.
4) The ramp voltage is applied to the non-inverting input of a voltage comparator. When the ramp voltage exceeds the reference voltage (from the Wow Range Control) the comparator output switches positive. This "resets" IC2A Pin 3 low.
5) The .15ufd capacitor discharges to this low level gradually turning off Q14.
6) The decreasing ramp voltage "closes" the voltage-controlled filter which decreases the harmonic content of the audio. This causes the "ow" part of the effect.

TREMOLO

The Vibes, Vibra Harp and 16' Flute have a tremolo effect. The vibrato signal is used to drive a lamp which gates audio signal through a photocell at the frequency of the vibrato oscillator. The following occurs when either the Vibes or Vibra Harp preset is selected:

1) Positive voltage is applied from the selected latch to the Vibes/Vibra Harp Tremolo and Keydown Enable IC3D and to the Lamp Driver Enable Q29.
2) The output of IC3D switches low, turning off the 16' Main Flute Volume Switcher Q36 (see Schematic 5). This increases the signal level to the tremolo photocell.
3) IC3C inverts the low outputted by IC3D to a high level. The high level saturates Vibes/Vibra Harp Tremolo Switcher Q32 and enables the keydown pulse input to Photocell Lamp Driver Q6 by reverse biasing Diode D3.
4) Lamp Driver Enable Q29 saturates applying positive voltage to the base of Q6 and through Q32 (due to its saturated condition) to the collector of Tremolo Driver Q31.
5) Tremolo Driver Q31 is modulated by the Vibrato Oscillator which in turn modulates the voltage at the base of Q6.
6) A positive pulse is applied through a .33ufd capacitor to the base of Q6 to develop the tremolo keydown pulse when an upper keyswitch is pressed.

If the 16' Flute tab is pressed, Q29 is turned on and a steady positive voltage is applied to Q6 enabling the 16' Main Flute signal to pass unmodulated. Turning the Leslie Tremolo Flute tab on ungrounds the input to 16' Main Flute Tremolo Switcher Q33. Switcher Q33 saturates causing the DC voltage applied to the Photocell Lamp Driver to be modulated by signal from the vibrato oscillator giving a tremolo effect to the 16' Main Flute.

VIBRATO

The Vibrato Oscillator IC1A applies a 6.25Hz sine wave to the tremolo driver, the CFG/Pedal Oscillator and through Vibrato Depth Adjust VR2 and the Vibrato tab to the Master Oscillator via Vibrato/Glide Driver Q1. Driver Q1 converts the vibrato signal into a low impedance, high current signal which is capable of shifting the Master Oscillator frequency.

Rhythm 'On' CFG Vibrato Killer Q3 saturates when a rhythm tab is turned on. This grounds the vibrato signal applied to the CFG/Pedal Oscillator.

VIBRATO EFFECTS

IC3A&B, Q23 VIBRATO DELAY TRIGGER, ENABLE

The Hawaiian Guitar, Vibra Harp, Piccolo and Violin presets use a delayed vibrato effect. The Vibrato Delay Trigger is enabled by grounding Pin 6 of IC3B through Vibrato Delay Enable Q23 when one of these presets is selected. At keydown, a positive voltage is applied to IC3A Pin 1 causing its output to switch low. IC3B momentarily senses this low through the .15ufd capacitor and its output switches high for the duration of the pulse. This positive voltage pulse causes Vibrato Delay Switcher Q5 to saturate which momentarily grounds the input to the vibrato oscillator.

NOTE: The Vibrato Delay for the Vibra Harp is applied to the Tremolo, resulting in a delayed tremolo effect.

Q5 VIBRATO DELAY SWITCHER

Transistor Q5 saturates when a positive voltage is applied to its base. This grounds the input to the vibrato oscillator, cancelling vibrato.

NOTE: When the Glide Switch is pressed, positive voltage is applied to the base of Q5, disabling the vibrato oscillator.

Q4, Q25, Q7 PRESET VIBRATO ENABLE & DEPTH SWITCHERS

The Hawaiian Guitar, Piccolo and Violin presets use a vibrato effect. Positive voltage is applied to the base of Q4 when one of these presets is selected. Q4 saturates which causes Q25 to cut off. This removes ground from the off buss of the Vibrato tab enabling vibrato signal to pass to the T.O.S. Master Oscillator.

The 4.7K and 3.3K resistors form a voltage divider which determines the preset vibrato depth. Selecting the Hawaiian Guitar preset causes Q7 to saturate. This bypasses a 47K resistor which increases the vibrato depth.

GLIDE

Pressing the Glide Footswitch (left side of expression pedal) applies positive voltage to the base of Vibrato/Glide Driver Q1. Q1 saturates which applies a low impedance, high current DC voltage to the Master Oscillator. This voltage reduces the feedback in the tank circuit and reduces the master oscillator frequency.

NOTE:
1) Vibrato will be cancelled while the glide switch is pressed.
2) If a Solo preset is selected, glide will be disabled except for the Solo voices.
3) The Solo Piano and Clavecin presets will have sustain when the glide switch is pressed.

SLOW ATTACK

The Accordion, Piccolo and Violin presets enable the slow attack effect. Slow Attack Driver Enable Q24 saturates applying positive voltage to the Slow Attack Modulator Driver Q8. At keydown, the .068ufd capacitor charges which applies an increasing voltage to Q8. As Q8 turns on, it applies an increasing positive voltage to the Percussion/Slow Attack Modulator. This gates the audio through the modulator giving the slow attack effect. At key release, the capacitor discharges through a diode and a 47K resistor to the low level at IC2 Pin 15 (see Schematic 15).

PERCUSSION [ONE SHOT]

Some of the preset voices use a one-shot percussion. The Harmonic Flute (4 & 2-2/3), Banjo and Mandolin will have a repeat percussion if the Repeat tab is on.

With the Repeat tab off and a percussion preset turned on, positive voltage is applied to the base of Q11. Percussion Drive Enabler Q11 saturates which causes Q10 to cut off. This ungrounds the output of Percussion Modulator Driver Q20. Percussion Emitter Follower Q22 is normally cut off holding Q20 off. Any keydown on the upper keyboard applies a pulse through the emitter follower to the base of Q20. Q20 saturates and applies a positive pulse through the Percussion Driver to the Percussion/Slow Attack Modulator gating the audio through the modulator.

The percussion length is determined by the discharge time of the .56ufd capacitor at the base of Q20. The Banjo and Harmonic Flute (4 & 2-2/3) use a short percussion. Using these presets will cause Snub Switcher Q21 to saturate. This switches a voltage divider into the base circuit of Q20. The .56ufd capacitor will discharge to this snub voltage giving a short percussion.

PERCUSSION [REPEAT]

The Banjo, Mandolin or Harmonic Flute (4 & 2-2/3) presets will repeat if the Repeat percussion tab is pressed. The positive voltage is removed from Q11 (disabling the Percussion Modulator Driver) and applied to Q12. Q12 saturates, cutting off Q9 which enables pulses from the Percussion Repeat Modulator Driver to be applied to the Percussion/Slow Attack Modulator giving a repeat percussion effect.

SCHEMATIC 3

LOWER DIODE KEYING

There are 44 Lower Keyboard DC Keyswitches. Pressing a Lower Keyboard key applies voltage through a coil to the anode of Diodes D4 & D5. This allows audio signal from the Tone Generators to pass to the 4- and 8-foot Lower Keyboard Diode Keying Groups. The Diode Keying Groups are represented by a bold line on Schematics 5 & 6.

Q111 ACCOMPANIMENT KILLER
With the Magic Chord tab on, the A1-A2 Lower Keyboard keys are disabled by Accompaniment Killer Q111. At this time the output from the Magic Chord preamp is routed to the Lower Keyboard filtering circuits. With the Magic Chord tab on, the A2 Lower Keyswitch becomes the 7th switch. Pressing the A2 Keyswitch at this time applies a positive voltage to 7th Enable IC24C which adds the 7th component to the Magic Genie Chord being played.

Q1 LOWER KEYBOARD KEYDOWN DETECTOR
The base of Q1 is normally high, keeping Q1 turned off. When a lower keyboard keyswitch is pressed, the base voltage is lowered and the transistor conducts applying a positive voltage to the Auto Start circuit.

SCHEMATIC 4

AUTOMATIC ORGAN COMPUTER [AOC]

Automatic Organ Computer (AOC) consists of Upper Keyboard AOC keyswitches (C1-C4), Lower Keyboard DC keyswitches (A1-C3), and in the Magic Chord mode the Magic Genie AOC Decoder is used in place of the first 12 DC keyswitches. Listed below is an example of what happens when a C Major chord is held on the Lower Keyboard and the C4 Upper Keyboard key is pressed.

1) With the AOC tabswitch on, holding a three-finger or a one-finger Magic C Major chord (C, E & G) on the Lower Keyboard applies positive voltage (from the A1-C3 Lower Keyboard keyswitches or the Magic Genie AOC Decoder) to the C, E & G AOC Drivers. Here the voltage is amplified and applied to the emitters of all the C, E & G AOC Keyers Q1-Q41.
2) Upon pressing the Upper Keyboard C4 Key:
   a) the C4 DC keyswitch contact (see Schematic 2) receives a positive voltage from its on buss and keys the C4 note through the Upper Keyboard Diode Keying circuitry.
   b) the C4 AOC keyswitch contact is grounded by its on buss which lowers the voltage on the base of nine AOC keyers - namely C#3, D3, D#3, E3, F4, F#4, G4, G#4 and A4. Since in this range only E3 and G4 have voltage applied to their emitters from the AOC Drivers, they are the only two AOC keyers that will conduct applying voltage to the Upper Keyboard E3 and G4 Diode Keying circuit. Thus, E3 and G4 will be heard along with C4.

Q86 AOC RANGE REGULATOR
The AOC Range Regulator applies voltage to the AOC drivers. The more positive the emitter voltage becomes, the wider the AOC keying range. When properly set, each AOC keyswitch will have a nine-note range.

SCHEMATIC 5

UPPER AND LOWER KEYBOARD FLUTE FILTERS

FLUTE FILTERS
Audio signal from the tone generators (via the upper keyboard diode keying circuitry) is divided into groups of six to seven notes each called diode keying groups. Each group of notes is applied to a Flute filter where the Flute tonality is developed. The Flute filters are low pass filters tuned to pass only the fundamental frequencies of the waveforms applied to them.

FET SWITCHERS
The FET switchers are N-channel depletion mode devices (normally conducting). Each FET is pinched off when the voltage at the gate is less positive than the voltage at the source and drain. Turning on the tab associated with the FET applies positive voltage to the gate enabling the audio to pass to the Flute mixing preamp.
NOTE: The voltage to the upper Flute tabs is switchable and will be low when a lighted preset and the cancel upper buttons are pressed. The voltage to the lower Flute tabs is switchable and will be low when a rhythm tab and the Auto Start tab are pressed and the rhythm is stopped.

IC1A FLUTE MIXING PREAMP
The upper and lower keyboard Flute audio is amplified by IC1A. The output of the Flute mixing preamp is applied to the output mixer.

TREMOLO

The 16' Main Flute audio is applied to the input of the light dependent resistor (LDR) from the 16' Main Flute Collector Preamp IC1D. If the Vibes or Vibra Harp preset or 16' Flute tab is selected, modulated positive voltage is applied to the lamp, causing it to turn on. As the intensity of the lamp increases, the resistance of the LDR decreases. The audio signal is gated through P1 at the rate of the modulated voltage applied to the lamp giving the tremolo effect.

IC2D amplifies the modulated audio. The 16' Main Flute Volume Switcher Q36 is normally saturated which reduces the volume of the 16' Main Flute signal. If the Vibes or Vibra Harp preset is selected, Q36 turns off increasing the volume for these presets. The 16' Main Flute Preamp IC1C amplifies the main Flute signal before routing it to the Main Volume Regulator IC4 (see Schematic 17).

IC1C, IC3D LOWER KEYBOARD FLUTE PREAMPS

Lower keyboard Flute audio is amplified by IC1C and applied to IC3D via the Lower Keyboard Flute Volume Switchers. The output of IC3D is applied to the Flute Mixing Preamp.

Q33, Q34 LOWER KEYBOARD FLUTE VOLUME SWITCHERS

Positive voltage is applied from the Lower Keyboard Flute Volume tabs to the bases of Q33 and Q34, saturating these transistors. Depending on which of the Lower Keyboard Volume tabs is on, voltage is removed from the base of one or both transistors. The resistance to ground at the output of the Lower Keyboard Flute Collector Preamp IC1C is varied regulating the amplitude of the signal applied to the Lower Keyboard Flute Preamp IC3D.

UPPER 4', 8' and 16' REED/STRING COLLECTOR PREAMPS

Audio signal from the diode keying groups is combined and applied to its associated collector preamp. Depending on the Reed/String tab or Symphonizer preset selected, Reed/String Switcher Q37, Q32 or Q39 will be turned on. The outputs of the upper keyboard 4', 8' and 16' R/S collector preamps are applied to various Reed/String filters and through resistors to the 8' and 16' Harmonic Mixers.

IC2A&B 8' HARMONIC MIXER

Audio from the 4' and 8' R/S Collector Preamps is applied to the 8' Harmonic Mixer IC2B where the audio frequencies are mixed. The resultant audio is inverted through IC2A and applied to the 8' R/S Filters.

IC2C&D 16' HARMONIC MIXER

Audio from the 4', 8' and 16' R/S Collector Preamps is applied to the 16' Harmonic Mixer IC2C where the audio frequencies are mixed. The resultant audio is inverted through IC2D and applied to the 16' R/S Filters.

IC1B PERCUSSION PREAMP

Switching a 4' or 2-2/3' percussion preset on applies audio to IC1B. IC1B amplifies this audio and routes it to the Percussion/Slow Attack Modulator.

SCHEMATIC 6

UPPER AND LOWER KEYBOARD SYMPHONIC STRING FILTERS

Passive filters are used for the upper and lower keyboard string voices. After being filtered, the upper 4' and 8' string audio is applied to collector preamps. The 16' string audio is developed by the 16' Harmonic Mixer (see Schematic 5).

The FET's are pinched off when the gate voltage is less than the voltage at the drain and source. Switching a string preset on, applies positive voltage to an FET, gating the FET on and applying string signal to a preamp. The voltage for the upper string FET's is applied low by IC15 when the Cancel Upper and an Orchestral or Solo preset button are pressed together. This cancels the upper strings. The lower strings are disabled when the Auto Start circuitry is engaged but no lower keys are pressed.

The upper 4-, 8- and 16-foot string audio is applied to the Upper String Preamps IC2C and IC1D. The output of IC1D is routed to the Output Mixer via the Upper String Volume Control. The lower 4- and 8-foot string audio is amplified by IC1A then routed to the Output Mixer via the Lower String Volume Control.

SCHEMATIC 7

REED CHORUS

Audio signals from the Reed/String Preamp are applied to the Chorus Input Low-Pass Filter where high frequency audio is filtered out. The Bucket Brigade phase modulates the audio at the rate of the Voltage-Controlled Oscillator clock causing a delay between the input and output signals. The Chorus Output Low-Pass Filter removes the high frequency clock component of the Voltage-Controlled Oscillator. When the Main Chorus switch is in the on position, the output of the Chorus Output Low-Pass

Filter is applied to the Main Volume Regulator. The Phase Modulated Audio is mixed with unmodulated audio signal at the Main Volume Regulator.

IC2A&B, Q1 & Q2 CHORUS SPEED AND VOLTAGE-CONTROLLED OSCILLATORS

The Chorus Speed Oscillator produces a 6Hz (1.25Hz with Celeste tab on) triangular waveform at the output of IC2A. The Voltage-Controlled Oscillator runs at a speed which is inversely proportional to the amplitude of the input from the speed oscillator. Since the amplitude of the input from the speed oscillator is constantly changing, the frequency of the Voltage-Controlled Oscillator varies. This in turn varies the delay time of the audio signal through the Bucket Brigade resulting in a phase-modulated signal.

IC3B INPUT LOW-PASS FILTER

Audio signals from the Reed/String Preamp are applied to the Chorus Input Low-Pass Filter. The input Low-Pass Filter prevents intermodulation by filtering out high frequency audio. The output of this filter is then applied to the input of the Bucket Brigade.

IC1 BUCKET BRIGADE

The Bucket Brigade is an analog shift register which samples the input audio signal at the rate of the Clock pulses from the Voltage-Controlled Oscillator. Each time a negative clock pulse is applied to Pin 5 and then Pin 2 of IC1, the audio signal is transferred to the next stage of the Bucket Brigade until it appears as output at Pin 6. This causes a delay between the input and output signal. Since the frequency of the clock pulses is changing, the delay time of the signal through the Bucket Brigade also varies, phase modulating the audio. The audio signal output from the Bucket Brigade is then applied to the Output Low-Pass Filter.

IC3A CHORUS OUTPUT LOW-PASS FILTER

The output Low-Pass Filter removes the high frequency clock component that is contained in the audio signal at the output of the Bucket Brigade. When the Reed Chorus Switcher is turned on, the output of the Output Low-Pass Filter is applied to the Main Volume Regulator (see Schematic 17).

SCHEMATIC 8

REED/STRING QUALITY CONTROL

Audio signal from the R/S collector amps is routed to various filtering circuits where the character of each voice is created. The output of each filter circuit is then routed through the Reed/String Preamp to the output mixer.

SYMPHONIC WOW FILTER

This circuit is a state variable filter that acts in conjunction with the 800P capacitors to form an R-C low pass filter. The filter is voltage controlled by the Symphonic Wow driver circuit (see Schematic 2). At keydown, a positive going ramp is applied to Pins 5 of IC1 and IC2. As the voltage becomes more positive, the harmonic content of the 16' R/S audio signal increases. This gives the "wa" effect to the symphonic wow voice. As the positive voltage decreases, the harmonic content decreases giving the "ow" effect. The output is a low impedance signal that is routed to the Symphonic Wow Preamp IC4D.

IC3, Q37 PERCUSSION/SLOW ATTACK MODULATOR, EMITTER FOLLOWER

Accordion, Violin and Piccolo Presets are the Slow Attack voices of the organ. Turning on any of these presets applies signal to the input of IC3. Signal is gated through IC3 when positive voltage is applied to Pin 5 from the Slow Attack Modulator Driver Q8 (see Schematic 2). This creates the Slow Attack effects for these voices. Banjo, Mandolin and Harmonic 4 & 2-2/3 are the repeat percussion voices of the organ. Turning on any of these presets applies signal to the input of IC3. Signal is gated through IC3 when positive voltage is applied from the Percussion Modulator Driver Q20 or the Repeat Drive Enabler Q9 to Pin 5 of IC3 (see Schematic 2). This creates the percussion and repeat percussion effects for these voices.

The Hawaiian Guitar, Harpsichord, Piano and Vibes use a solo (one shot) percussion to create the strike tone at keydown.

The output of the Emitter Follower Q37 is a low impedance signal which is applied directly to the Reed/String Preamp.

FET SWITCHERS

The FET switchers are N-Channel depletion mode devices (normally conducting). They are pinched off when the voltage at the gate is less positive than the voltage at the source and drain. Turning on the voice associated with each switcher applies a positive voltage to the gate of the FET, returning the FET to its unbiased state. This permits the audio signal to pass through the FET. The upper keyboard tabswitch voltage is switchable. When an orchestral symphonizer preset and the Cancel Upper button are pressed, the +14 volts to the upper tabs are switched low, cancelling the upper keyboard voices.

The tabswitch voltage for the lower Reed/String voices is supplied by the Rhythm Start/Stop Enable IC24. When the Auto Start tab and a rhythm tab are pressed (before a lower keyswitch is pressed), the switched voltage will be low. This disables the lower Reed/String voices until a lower keyswitch is pressed.

IC5 LOWER KEYBOARD MODULATOR

Audio signal from the Lower Keyboard R/S Filters is applied to the input of Modulator IC5. Here the signal is amplified. Signal can only pass through the Modulator when a positive voltage is applied to Pin 5 from the Lower Keyboard Modulator Driver. With no rhythm on, a steady positive voltage is applied to Pin 5 holding the Modulator on, allowing signal to pass through unmodulated. With a Rhythm Tabswitch on, positive voltage pulses are applied to Pin 5 from the Lower Keyboard Modulator Driver, gating the signal through the Modulator at the speed (tempo) of the rhythm. The signal is then applied to the Reed/String Preamp.

LOWER KEYBOARD ACCENT

The lower keyboard Guitar or Banjo will have an accent depending on the combination of Piano, Guitar and Banjo tabs selected (see Truth Table below). This accent is in addition to the normal lower keyboard modulation (see Lower Keyboard Modulator IC5).

LOWER TABSWITCH			Applied to MODULATOR	Applied to Modulator with ACCENT
Piano	Guitar	Banjo		
ON	ON	OFF	Piano	Guitar
ON	OFF	ON	Piano	Banjo
OFF	ON	ON	Guitar	Banjo
ON	ON	ON	Piano & Guitar	Banjo

Fig. 1 - Lower Keyboard Accent

With the rhythm off, Diodes D18 and D19 are reverse biased by positive voltage from IC25D Pin 8 applied through D9 and D16. This enables the lower keyboard Guitar and Banjo switchers to be gated on when the associated tab is pressed.

The following conditions must be met to enable the Lower Keyboard Accent circuit:

1) At least two of the lower keyboard Piano, Guitar or Banjo tabs must be pressed.
2) The rhythm must be playing.

When the rhythm is playing, the input from IC25D Pin 8 is low. This enables positive pulses from ROM 2 to be applied to the cathode side of D18 and D19 through Buffer IC8E. Depending on the tabs selected, steady positive voltage may be applied to the cathode of D18 from IC25E or D4. This disables the accent for the Lower Keyboard Guitar. As the pulses from ROM 2 are applied to the cathode of D18 or D19 the tabswitch voltage is modulated. The FET switcher gates audio signal through the FET. This results in an accented voice in addition to the normal lower keyboard modulation.

Q26, Q27 LOWER KEYBOARD REED/STRING VOLUME SWITCHERS

When the Lower Volume tabs are off, Q26 and Q27 are saturated. A voltage divider is formed between the 6.8K resistor (emitter Genie Modulator Driver Q8 - see Schematic 11) and the 2K resistor to ground (through Q26). Resistors are added to the voltage divider when the Lower Medium or Lower Full tab is switched on, raising the junction of the 6.8K and 2K resistors higher above ground. This increases the voltage into the Lower Keyboard Modulator, increasing the volume of the lower R/S voices.

IC4A REED/STRING MIXING PREAMP

The upper keyboard Reed/String voices (except percussion and slow attack voices) are amplified by IC4A. The amplified signal is then applied to the Reed/String Preamp.

IC4C REED/STRING PREAMP

The upper and lower keyboard Reed/String voices are amplified by IC4C. The audio signal is then routed to the Output Mixer and to the Reed Chorus circuit.

SCHEMATIC 9

FLUTE & STRING CHORUS MODULATOR

Audio signal from the Flute/String Chorus Audio Mixer is applied to the Phase One, Phase Two and Phase Three Bucket Brigades. The audio signal is shifted through each bucket brigade at the frequency of the Voltage Controlled Oscillator (VCO). This causes a delay between the input and output signals, phase modulating the audio. The Output Low Pass Filters remove the high frequency clock component of the VCO. The phase modulated signal is applied to the Output Mixer where it is mixed with unmodulated audio signal.

NOTE: The operation of all three phases of the chorus modulator is identical. For the following discussion, references for Phase One will be used.

FAST CLOCK, DIVIDER [SLOW CLOCK, DIVIDER]

The fast clock oscillates at a frequency of 19.6 Hz (Slow Clock = 2.2Hz). The clock pulses are applied to a J-K flip flop which divides the clock frequency by three. The phase three output is shifted by 120° with respect to the phase one output. The phase one and phase three outputs are applied to an inverter which develops the phase two output.

CIRCUIT DESCRIPTION

FILTERS

The square wave outputs of the dividers are applied to the Phase 1, 2 and 3 Filters where the clock pulses are changed into sine waves.

VCO DRIVER

The high and low frequency clock pulses are summed together by the VCO Driver. The amplitude of the high frequency clock is attenuated then superimposed on the low frequency clock.

VOLTAGE CONTROLLED OSCILLATORS [VCO]

As the amplitude of the voltage applied to the bases of the VCO transistors (Q5&6) changes, the frequency of the oscillator changes. The frequency varies between 220KHz and 400KHz.

OSCILLATOR ANTI-LOCK

It is possible for a VCO to stop oscillating. Should this occur, both VCO transistors would be saturated. This would apply a low to the base of Q7 causing Q8 to saturate. This changes the bias at the base of Q5 triggering the VCO back into oscillation.

BUCKET BRIGADES

The Bucket Brigade is an analog shift register which samples the input audio signal at the rate of the Clock pulses from the Voltage-Controlled Oscillator. Each time a clock pulse is applied to Pin 1 of IC7, the audio signal is transferred to the next stage of the Bucket Brigade until it appears as output. This causes a delay between the input and output signal. Since the frequency of the clock pulses are constantly varying, the delay time of the signal through the Bucket Brigade also varies, phase modulating the audio. The audio signal output from the Bucket Brigade is then applied to the Low-Pass Filter.

CHORUS LOW-PASS FILTERS

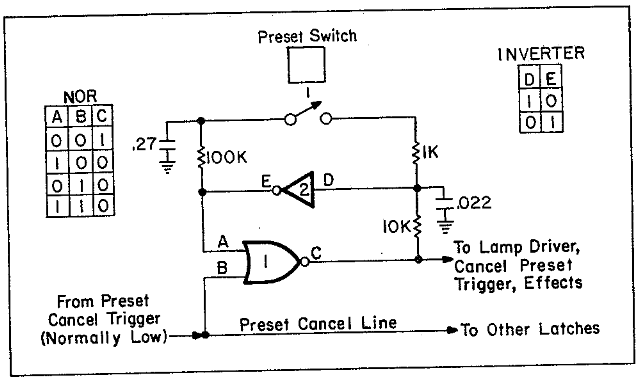
The output Low-Pass Filter filters out the high frequency clock component that is contained in the audio signal at the output of the Bucket Brigade. The filtered audio signal is applied to the Output Mixer.

SCHEMATIC 10

LIGHTED BUTTON LOGIC

PRESET LATCHES

Each lighted pushbutton switch uses a latch circuit to enable the audio and effects for the chosen preset. Only one preset can be enabled at a time (Solo and Orchestral Presets). The Symphonic String, Symphonic Wow, Solo Keying and Cancel Upper Latches are independently activated and cancelled.



NOR

A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

INVERTER

D	E
1	0
0	1

Preset Switch
1
.27
100K
1K
E
2
D
.022
10K
A
B
1
C
To Lamp Driver, Cancel Preset Trigger, Effects
From Preset Cancel Trigger (Normally Low)
Preset Cancel Line
To Other Latches

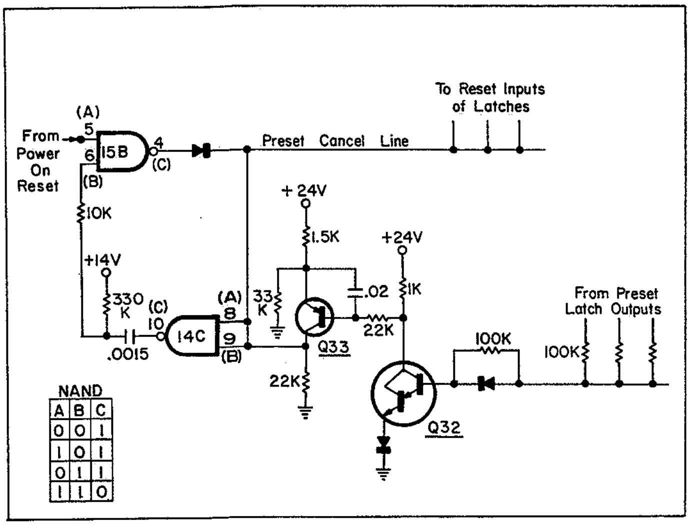
Fig. 2 - Typical Preset Latch

ACTIVATING A PRESET [See Fig.2]

A positive pulse is applied from the preset cancel trigger to Pin B of IC1 at organ turn on. This ensures that the output of the latch (Pin C) will be low. This low is inverted through IC2 and applied as a high to Pin A which latches Pin C low. Pin E applies a positive voltage potential to the .27ufd capacitor. Pressing the preset switch applies this positive potential to Pin D of IC2. The voltage is inverted to a low. Because both inputs to IC1 are now low, its output switches high. This high level is inverted to a low by IC2 and applied to Pin A which will latch Pin C high. This positive voltage enables the lamp, the audio switcher and any effects (percussion, slow attack, etc.) associated with the selected preset.

CANCELLING A PRESET [See Fig.2]

Once the preset is activated, a low voltage potential is present at the .27ufd capacitor. If the active preset switch is pressed again, the high level at Pin D will switch to the low potential at the capacitor. Pin E will switch high causing Pin C to switch low. This latches Pin C low by applying this low back to Pin D.



NAND

A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

Fig. 3 - Preset Cancel Trigger

CHANGING PRESETS [See Fig.3]
References for Orchestral Presets Cancel Trigger given. Only one preset can be activated at a time. The active preset applies positive voltage to the base of Q32. This voltage is too low to saturate Q32. If a second preset is pressed, the combined voltages from both presets will saturate Q32. Q33 saturates applying a high to the preset cancel line and IC14C. The output of IC14C switches low. Pin 6 of IC15B momentarily senses this low and a positive pulse is outputted from Pin 4. This cancels the first preset (see example Fig.2) which removes one of the voltages applied to Q32 turning this transistor off. The preset cancel line switches low at the end of the reset pulse.

POWER ON RESET
At power turn on, the .27ufd capacitor appears to be a short to the DC voltage. This applies a positive voltage to Inverter IC14A. Its output switches low which:

1) causes the Presets Cancel Triggers to activate applying a reset pulse to the latches.

2) is inverted to a high by IC14D and resets the Rhythm and the Symphonic String, Wow, Solo Keying and Cancel Upper Latches.

CANCEL UPPER

Any combination of upper keyboard tabs (including Symphonic String and Symphonic Wow) may be used with an Orchestral Preset and/or a Solo Preset. When the Cancel Upper button is pressed, the Orchestral Presets (including Symphonic Wow) will be heard and the upper tabs (including Symphonic Strings) will be cancelled. If a Solo Preset button and the Cancel Upper button are pressed, the upper tabs, Symphonic Strings and Orchestral Preset will be cancelled.

Exceptions:

1. The Harmonic 2-2/3 Preset will not cancel.
2. The AOC will play the selected Orchestral Preset when this feature is used with the Cancel Upper.
3. If a Solo Preset is selected, the AOC will play on both the upper keyboard tabs and the Orchestral Preset.

Pressing the Cancel Upper button applies a low to the enable input of IC13C Upper Tabswitch Cancel Enable and IC13D DC Keying Cancel Enable.

The following sequence occurs when the Cancel Upper and an Orchestral Preset button are pressed:

1) A low is applied from the Cancel Upper Latch to one input of the Upper Tabswitch Cancel Enable (IC13C Pin 9).

2) A positive voltage is applied from the lamp driver transistor of the active Orchestral Preset to the base of Orchestral Preset 'On' Detector Q31.

3) Q31 saturates which applies a low to Upper Tabswitch Cancel Enable IC13C Pin 8.

4) The output of IC13C (Pin 10) switches high (because both inputs to IC13C are low).

5) Pin 12 of Upper Keyboard Tabswitch Bus Driver IC15D will be high when none of the solo presets are pressed. Since both inputs to IC15D are high, the output Pin 11 switches low. This removes voltage from the upper tabswitches and Symphonic String Switchers, cancelling the upper keyboard voices.

The following sequence occurs when the Cancel Upper and a Solo Preset button are pressed:

1) A low is applied from the Cancel Upper latch to one input of DC Keying Cancel Enable (IC13D Pin 12).
2) A positive voltage is applied from the lamp driver transistor of the active Solo Preset to the base of Solo Preset 'On' Detector Q34.
3) Q34 saturates which a) disables the Master Oscillator Glide and b) applies a low to DC Keying Cancel Enable IC13D Pin 13.
4) The output of IC13D (Pin 11) switches high (because both inputs to IC13D are low).
5) The high level outputted by IC13D Pin 11 causes Q38 to saturate. This disables the Flute 2-2/3 FET switcher and cuts off Q39.
6) When Q39 cuts off, Q37 Upper DC Keyswitch Bus Driver also cuts off. This cancels the upper keyboard by removing the DC keying voltage from the keyswitches.

SCHEMATIC 11
RHYTHM

IC27 RHYTHM FUNCTION GENERATOR

The Rhythm Function Generator (RFG) IC27 is the source of all triggering pulses for the rhythm instrumentation, Genie and alternating bass. Serial data encoded with rhythm time point information is outputted from Pin 7 of the RFG. (See Fig. 7 for example of time point data). This data along with rhythm tab data is applied to the Magic Melody and Swing Bass Read Only Memories (ROM) where the triggering pulses for the Magic Melody and Swing Bass are developed.

The RFG is enabled by applying a low to Pin 26 (see Rhythm Start/Stop). Pressing a Rhythm tabswitch applies a positive voltage to the RFG. This enables the logic sequence for the rhythm chosen. The Track Select switch performs three functions:

1) It determines the Rhythm pattern that will be heard with a particular Rhythm by selecting the track that the logic sequence will follow.
2) It reduces the Clock Multivibrator speed for the Track A patterns by placing a .047uf capacitor in parallel with the .15uf feedback capacitor.
3) When the Ballad is selected (Track A, Rhythm 1) a high level is applied to the Ballad Intro 'On' Detector.

The outputs of the RFG are positive pulses which are applied to the Instrumentation, Bass and Lower Keyboard Modulator circuits. Track A patterns 1 through 4 are triplet rhythms (24 time points). Patterns A5 and A6 are 3/4 rhythms (18 time points). All other rhythms are in 4/4 time (32 time points). (See Rhythm Patterns Diagram.)

IC21A, IC21B CLOCK MULTIVIBRATOR

The Clock Multivibrator oscillates at a speed which is controllable from approximately 3 to 44 Hz. Outputs of the Clock Multivibrator are applied to the Repeat Modulator Driver and through Ballad Intro Divider IC29A to the Rhythm Function Generator and to the Rhythm Time Point Shift Register (see Schematic 12).

IC29A, IC20D BALLAD INTRO DIVIDER, DIVIDER ENABLE

Normally, Pin 12 of IC20D Divide-by-Two Enable is low. IC20D functions as an inverter. Each time the Clock Multivibrator output (Pin 4 of IC21B) goes low, a negative going pulse is developed across a .001uf capacitor connected to Pin 13 of IC20D. With each negative going pulse applied to Pin 13 a positive pulse is outputted from IC20D to the set input of IC29A. This causes the Q output to switch high and the Q-bar output to switch low. The next positive going edge of the Clock Multivibrator causes the Q output to switch low (because the Q-bar output is connected to the D input of IC29A). The result is that the Q-bar output is changing in phase with the clock input (Q-bar goes high when Clock Multivibrator output goes high).

IC22D BALLAD INTRO 'ON' DETECTOR

When the Ballad rhythm is selected (Track A, Rhythm 1) and the Intro button is pressed, both inputs to IC22D, Ballad Intro 'On' Detector are high. The output of IC22D switches high which disables IC20D. The output of IC20D switches low which enables Ballad Intro Divide-by-Two Divider IC29A to function as a divider. This reduces the speed of the intro pattern when the Ballad rhythm is selected.

CIRCUIT DESCRIPTION

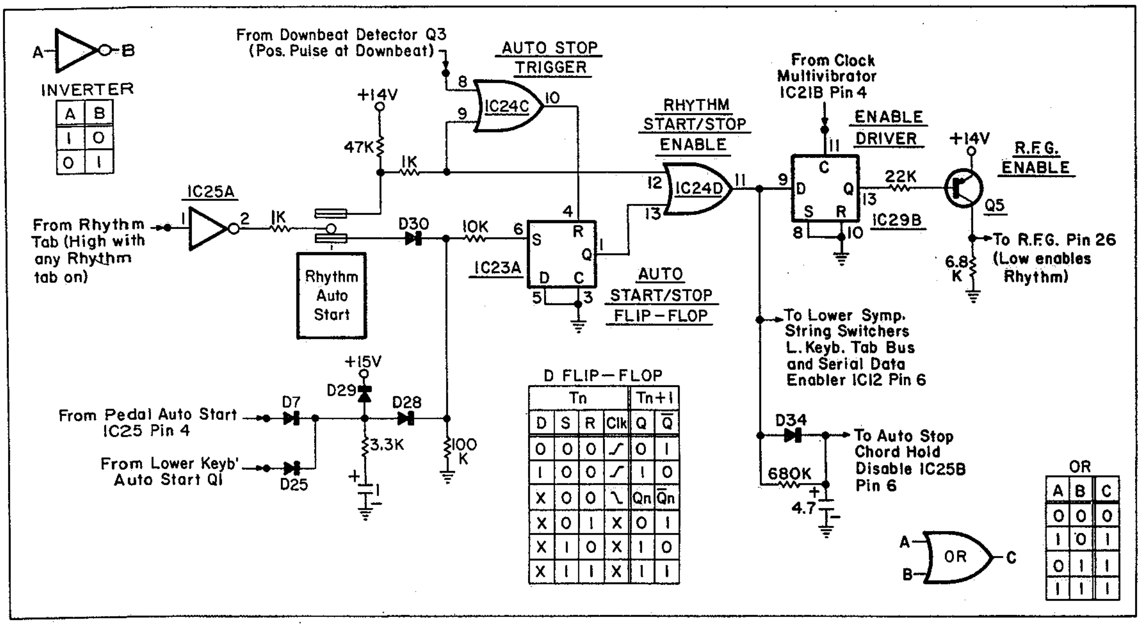

INVERTER
A B
1 0
0 1
From Downbeat Detector Q3 (Pos. Pulse at Downbeat)
AUTO STOP TRIGGER
+14V
47K
1K
IC24C
RHYTHM START/STOP ENABLE
IC24D
From Clock Multivibrator IC21B Pin 4
ENABLE DRIVER
+14V
22K
IC29B
R.F.G. ENABLE
Q5
To R.F.G. Pin 26 (Low enables Rhythm)
6.8K
IC25A
From Rhythm Tab (High with any Rhythm tab on)
1K
D30
10K
IC23A
Rhythm Auto Start
AUTO START/STOP FLIP-FLOP
To Lower Symp. String Switchers L.Keyb. Tab Bus and Serial Data Enabler IC12 Pin 6
+15V
D29
D28
D7
From Pedal Auto Start IC25 Pin 4
From Lower Keyb' Auto Start Q1
D25
3.3K
100K
D FLIP-FLOP
Tn Tn+1
D S R Clk Q Q̄
0 0 0 ↗ 0 1
1 0 0 ↗ 1 0
X 0 0 ↘ Qn Q̄n
X 0 1 X 0 1
X 1 0 X 1 0
X 1 1 X 1 1
D34
To Auto Stop Chord Hold Disable IC25B Pin 6
680K
4.7
OR
A B C
0 0 0
1 0 1
0 1 1
1 1 1

Fig. 4 - Rhythm Auto Start

Q7 REPEAT MODULATOR DRIVER

The negative going edge of IC21A Pin 2 develops negative pulses across a .033uf capacitor. These pulses are inverted by IC21F and applied as positive pulses to the base of Q7. This repeatedly turns Q7 on, creating a series of positive output pulses at its emitter. These positive output pulses are then routed to Pin 5 of the Percussion/Slow Attack Modulator via the Percussion Repeat Drive Enabler where they gate signal through the modulator at the speed of the rhythm and create the repeat effect for the Mandolin, Banjo and Harmonic Flute voices.

RHYTHM START/STOP

The rhythm can be started normally by turning on a Rhythm switch or automatically by: 1) Placing the Rhythm Start Normal/Auto tab to Auto, 2) Turning on a Rhythm switch and 3) Pressing a lower keyboard key or a bass pedal. The rhythm pattern will then stop automatically after all lower keyboard keys and Bass Pedals are released.

Normal [See Fig. 4]

The data input to Enable Driver IC29B is normally high. Pulses from the clock multivibrator are applied to the clock input of IC29B. Because the data input is high, the Q output of IC29B will be high. This high level cuts off RFG Enable Q5 which applies a low to the enable input (Pin 26) of the RFG. This enables the RFG. When a rhythm tab is pressed, positive voltage is applied to the associated rhythm input of the RFG. The RFG outputs the rhythm sequence as long as a rhythm tab is on.

Auto Start [See Fig.4]

When the Rhythm Start tab is in the Auto position, the initial conditions are as follows:

1) The set input to Auto Start/Stop Flip-Flop IC23A is low (because at this time a pedal or lower key-switch has not been pressed).
2) A high is applied to the reset input of Auto Start/Stop Flip-Flop IC23A via Auto Stop Trigger IC24C. This resets the Q output of IC23A low.
3) Pressing a rhythm tab applies a high to the Inverter IC25A which makes its output low.
4) The low outputted by IC25A is applied to the reset input of Auto Start/Stop Flip-Flop IC23A via Auto Stop Trigger IC24C. The Q output of IC23A will remain low.
5) Both inputs to Rhythm Start/Stop Enable IC24D are now low. (Q output of IC23A and the output of Inverter IC25A). The output of IC24D will be low.
6) A low is clocked through Enable Driver IC29B which causes RFG Enable Q5 to saturate. This applies a high to the RFG which disables the rhythm.
7) The low output of IC24D disables the chord hold function of the CFG, the lower keyboard Symphonic Strings, the lower keyboard tabs, and the data input to the Magic Genie 4' and AOC Decoder.

Under the above conditions no rhythm, Magic Chords, Magic Melody, Swing Bass or Genie Bass will be heard.

Pressing a lower keyboard key or bass pedal causes the following sequence to occur:

1) Positive voltage is applied from the Lower Keyboard or Pedal Auto Start circuits to the set input of IC23A causing the Q output to switch high.
2) This high is applied through Rhythm Start/Stop Enable IC24D to the D input of IC29B and enables the chord hold function of the CFG, the lower keyboard Symphonic Strings, the lower keyboard tabs and the data input to the Magic Genie 4' and AOC Decoder.
3) The high is clocked through IC29B which causes RFG Enable Q5 to cut off. This makes the enable input to IC27 low which enables the rhythm.

The rhythm pattern will be outputted as long as a lower keyswitch or bass pedal is pressed.

Auto Stop [See Fig. 4]

The enable input to the Rhythm Function Generator (Pin 26 of IC27) is an in/out port. When Pin 26 is applied low, the RFG is enabled. At each downbeat, Pin 26 of the RFG outputs a positive sync pulse. At key release, the rhythm will continue to play. The Magic Chord, Magic Melody, Swing Bass or Genie Bass will continue to play if they are enabled.

When the rhythm pattern reaches the downbeat, the following sequence occurs:

1) A positive sync pulse is outputted from Pin 26 of the RFG. The negative going edge is applied through a .01 capacitor to the base of Q3 Downbeat Detector.
2) The collector of Q3 outputs a positive pulse which is applied via IC24C to the Reset input of IC23A. Because the Set input to IC23A is low (due to the release of the lower keyboard keys), the Q output resets low.
3) The low at the Q output of IC23A is applied through IC24D to the D input of IC29B.
4) A low is clocked to the Q output of IC29B which causes Q5 to saturate. This applies a high to the RFG disabling the rhythm.
5) The low output of IC24D disables the chord hold function of the CFG, the lower keyboard Symphonic Strings, the lower keyboard tabs, and the data input to the Magic Genie 4' and AOC Decoder.

Q3 DOWNBEAT DETECTOR

When the Rhythm Function Generator is enabled, Pin 26 is applied low. At each downbeat, Pin 26 outputs a positive sync pulse. The negative going edge develops a pulse across a .01uf capacitor. This causes Q3 to momentarily saturate and output a positive pulse at its collector. This positive pulse is applied to the Downbeat Lamp Driver, Intro Lamp Driver and Auto Stop Trigger.

Q2 INTRO & DOWNBEAT LAMP DRIVER

Each time a positive pulse is outputted from Downbeat Detector Q3, Intro & Downbeat Lamp Driver Q2 will momentarily saturate. This causes the Downbeat Lamp to flash at each downbeat. If the Intro button had been pressed, a steady posiive voltage would be applied from Intro Lamp Driver Latch IC23B to the base of Q2, holding the lamp on for the duration of the intro pattern.

IC22C, Q33 RIM SHOT ENABLE, LOW DRUM KILLER

When the Rhythm 3 tab is pressed, positive voltage is applied to the base of Q33. Q33 saturates, grounding the input to the Low Drum Generator. The Rhythm 3 tab applies positive voltage to Pin 9 of Rim Shot Enable IC22C enabling this gate. When RFG Pin 8 outputs a pulse, it is applied through IC22C to the Rim Shot Generator.

IC28D, Q12 RHUMBA BRUSH SNUB ENABLE, SWITCHER

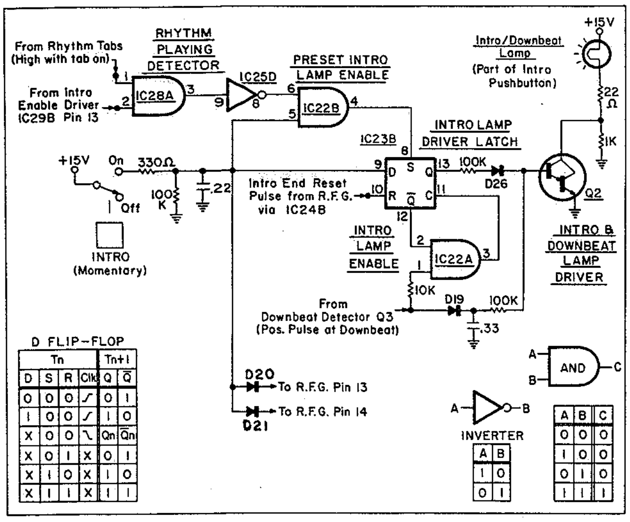
When the Rhumba rhythm pattern (Track B, Rhythm 4) is selected, both inputs to Rhumba Brush Snub Enable IC28D will be high, switching the output high. This causes Snub Switcher Q12 to saturate which reduces the amplitude of the brush keyer pulse (RFG IC27 Pin 22).

IC25F POWER ON RESET

At power turn on, a positive pulse is applied to the reset input of Intro Lamp Driver Latch IC23B (via Intro End Reset IC24B) to ensure the Intro lamp will be off. IC25F inverts the power on reset pulse and applies it to the Rhythm and Magic Chord 'On' Detector (see Schematic 12).

INTRO [See Fig.5]

Each time the Intro button is pressed, positive voltage is applied to pins 13 and 14 of the RFG which resets the RFG and enables the intro sequence. The intro pattern will repeat as long as the intro button is pressed and held. If the Intro button is pressed and released, the intro sequence will play to its conclusion and then play the selected rhythm. The position of the Rhythm Select Switch determines the Intro Pattern that will be heard. Tracks B and C use Intro I and Track A uses Intro II.


From Rhythm Tabs (High with tab on)
RHYTHM PLAYING DETECTOR
From Intro Enable Driver IC29B Pin 13
IC28A
IC25D
PRESET INTRO LAMP ENABLE
IC22B
Intro/Downbeat Lamp (Part of Intro Pushbutton)
+15V
22 Ω
1K
INTRO LAMP DRIVER LATCH
IC23B
+15V
On
330Ω
100 K
.22
Off
INTRO (Momentary)
Intro End Reset Pulse from R.F.G. via IC24B
100K
D26
Q2
INTRO & DOWNBEAT LAMP DRIVER
INTRO LAMP ENABLE
IC22A
10K
D19
100K
From Downbeat Detector Q3 (Pos. Pulse at Downbeat)
.33
D20
To R.F.G. Pin 13
To R.F.G. Pin 14
D21
AND
INVERTER

D FLIP-FLOP

Tn				Tn+1	
D	S	R	Clk	Q	$\overline{Q}$
0	0	0	/	0	1
1	0	0	/	1	0
X	0	0	\	Qn	$\overline{Qn}$
X	0	1	X	0	1
X	1	0	X	1	0
X	1	1	X	1	1

INVERTER

A	B
1	0
0	1

AND

A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 5 - Intro Lamp Enable

Preset Intro Lamp Enable
[See Fig. 5]

Before starting a rhythm (Rhythm tabs off or Auto Start enabled), the Intro may be preset as follows:

1) The output of Rhythm Playing Detector IC28A Pin 3 will be low (because either a rhythm tab has not been pressed or the Auto Start is enabled but the rhythm has not been started).
2) The low output of IC28A is inverted to a high and applied to Preset Intro Lamp Enable IC22B Pin 6.
3) Pressing the Intro button applies positive voltage to Pins 13 and 14 of the RFG, enabling the RFG to output the Intro pattern. Positive voltage is applied to IC22B Pin 5 causing its output to switch high (because Pin 6 is also high). This high is applied to the Set input of Intro Lamp Driver Latch IC23B.
4) The high applied to the Set input of Intro Lamp Driver Latch IC23B causes the Q output to switch high.
5) The high outputted by IC23B Pin 13 causes Intro and Downbeat Lamp Driver transistor Q2 to saturate lighting the lamp.

Starting the rhythm causes the intro to play. At the conclusion of the intro sequence, the intro lamp is turned off as follows:

1) When the rhythm was started, both inputs to Rhythm Playing Detector IC28A switched high. The high outputted from IC28A is inverted to a low and applied to the Set input of IC23B Intro Lamp Driver Latch.
2) At the conclusion of the Intro, the RFG Pin 19 outputs a positive pulse. This pulse is applied to the reset input of IC23B which causes its Q output to switch low, causing Intro and Downbeat Lamp Driver Q2 to cut off which turns off the lamp.

Rhythm Playing Intro Lamp Enable
[See Fig. 5]

If the Intro button is pressed while a rhythm is playing, the following sequence occurs:

1) Initially, the Q output of IC23B is low (Q-bar high) so the Intro lamp is off.
2) When the Intro button is pressed, the RFG resets and outputs a pulse at Pin 26 which causes Downbeat Detector Q3 to output a positive pulse.
3) The reset pulse is applied to one input of Intro Lamp Enable IC22A. The other input to IC22A is the Q-bar output of IC23B which at this time is high. Because both inputs to IC22A are high, its output switches high and clocks Intro Lamp Driver Latch IC23B.
4) The data input to IC23B is high (because the Intro button is pressed). This high is clocked to the Q output of IC23B which causes Intro and Downbeat Lamp Driver Q2 to saturate, lighting the lamp.

INSTRUMENTATION

The Instrumentation circuits produce the instrument voices for the rhythm. The generator outputs are applied to the rhythm preamp where the voices are amplified and sent via the rhythm volume control to the output preamp.

IC1, IC2, IC3, IC4C RHYTHM GENERATORS

The Rhythm Generators are tuned resonant circuits. Positive pulses from the Rhythm Function Generator cause the circuits to generate short bursts of audio oscillation with diminishing amplitudes. The outputs of the Rhythm Generators are combined and applied to the Left and Right Channel Drum Amps IC4B and IC4D.

IC10 NOISE GENERATOR

The Noise Generator produces a random noise signal. When the Snare, Brush or Cymbal Keyer circuits operate, this signal is passed through D47 and D45, 46 or 48 to the Cymbal, Snare or Brush Voicing circuits. The noise signal is applied to the Jazz Flute Noise Keying circuit (see Schematic 16).

Q17, Q18, Q19 SNARE KEYER, SNARE VOICING

Positive pulses from Pin 5 of IC27 are applied to the High Drum and Low Drum generators causing them to oscillate producing the High and Low Drum voices. These audio signals are then combined and routed to the Left and Right Channel Amps. Pin 5 also applies a positive pulse to the base of Q17, Snare Keyer, turning it on. This causes positive voltage to tun on Diodes D48 and D47 which allow noise signal to pass to the Snare Voicing circuit Q18 and Q19 where it is voiced for proper tonality. The voiced noise signal at the output of Q19 combines with the High and Low Drum signals, together creating the Snare Drum voice.

NOTE: When the Rhythm 3 tab is pressed, the Low Drum generator is disabled and the Rim Shot generator is enabled giving a rim shot effect to the Swing, Bosa Nova and Soft Rock rhythm patterns.

Q9-12 CYMBAL KEYER, CYMBAL VOICING

Positive pulses from Pin 21 of IC27 are applied to the base of Q10, Cymbal Keyer, turning it on. This applies positive voltage to Diodes D45 and D47 which now conducts allowing noise signal to pass to the Cymbal Voicing circuit. Here the signal is voiced for proper Cymbal tonality then applied to the Left and Right Channel Brush Amps. With each positive pulse applied to Q10 a .27uf capacitor is charged. The length of the Cymbal tone is regulated by varying the discharge time of this capacitor. Depending on the rhythm selected, positive pulses are outputted from ROM 2 (see Schematic 12) which causes Cymbal Snub Switcher Q9 to saturate. This connects a resistor to ground which regulates the discharge rate of the .27uf capacitor, thereby regulating the length of the cymbal tone.

Q13-16 BRUSH KEYER, BRUSH VOICING

Positive pulses from Pin 22 of IC27 are applied to the base of Q14, Brush Keyer, turning it on. This applies positive voltage to Diodes D46 and D47 which now conduct allowing noise signal to pass to the Brush Voicing circuit. Here the signal is voiced for proper Brush tonality then applied to the Left and Right Channel Brush Amps. With each positive pulse applied to Q14, a .27uf capacitor is charged. The length of the Brush tone is regulated by varying the discharge time of this capacitor. Depending on the rhythm selected, positive pulses are outputted from ROM 2 (see Schematic 12) which causes Brush Snub Switcher Q13 to saturate. This connects a resistor to ground which regulates the discharge rate of the .27uf capacitor, thereby regulating the length of the brush tone.

IC4B, IC4D, IC5B, IC5C LEFT AND RIGHT CHANNEL DRUM AND BRUSH AMPS

Audio signals created by the Instrumentation circuits are applied to the Drum and Brush Amps where the signal is amplified before being applied to the Left and Right Channel Mixers.

IC4A RIGHT CHANNEL MIXER

The right channel drum and brush signals are balanced and applied to Right Channel Mixer IC4A where the signal is amplified before being applied to the Output Mixer via the Rhythm Volume Control.

IC5A LEFT CHANNEL MIXER

The left channel drum and brush signals are balanced and applied to Left Channel Mixer IC5A where the signal is amplified before being applied to the Output Mixer via the Rhythm Volume Control.

Q8 GENIE MODULATOR DRIVER

Positive voltage pulses from Pin 23 of IC27 are applied to the base of Genie Modulator Driver Q8 causing it to turn on. This applies positive voltage pulses to Lower Keyboard Modulator Pin 5 (see Schematic 8) gating the Lower Keyboard signal through the Lower Keyboard Modulator in a pattern determined by the rhythm selected. Pin 24 of IC27 is normally low. In this condition the Lower Keyboard audio has a staccato sound. For certain rhythm time points, Pin 24 goes positive, removing the discharge path for the .22uf capacitor at the base of Q8. This gives a sustain to the modulated audio. If no rhythm tabs are pressed, a steady positive voltage is applied from Inverter IC25A through D24 to the base of Q8. This holds the Lower Keyboard Modulator on and allows the Lower Keyboard signal to pass unmodulated.

SCHEMATIC 12

MAGIC MELODY & SWING BASS LOGIC

OVERVIEW

The Magic Melody and Swing Bass Logic circuits can be divided into two sections, keying and audio.

The keying section consists of two read only memories (ROM). A ten bit address (combination of ten high/low inputs) is applied to each ROM input. This address has information pertaining to the rhythm track and tab selected and the active rhythm time point. Each rhythm time point causes the outputs of the ROM to change which triggers the Magic Melody and Swing Bass notes.

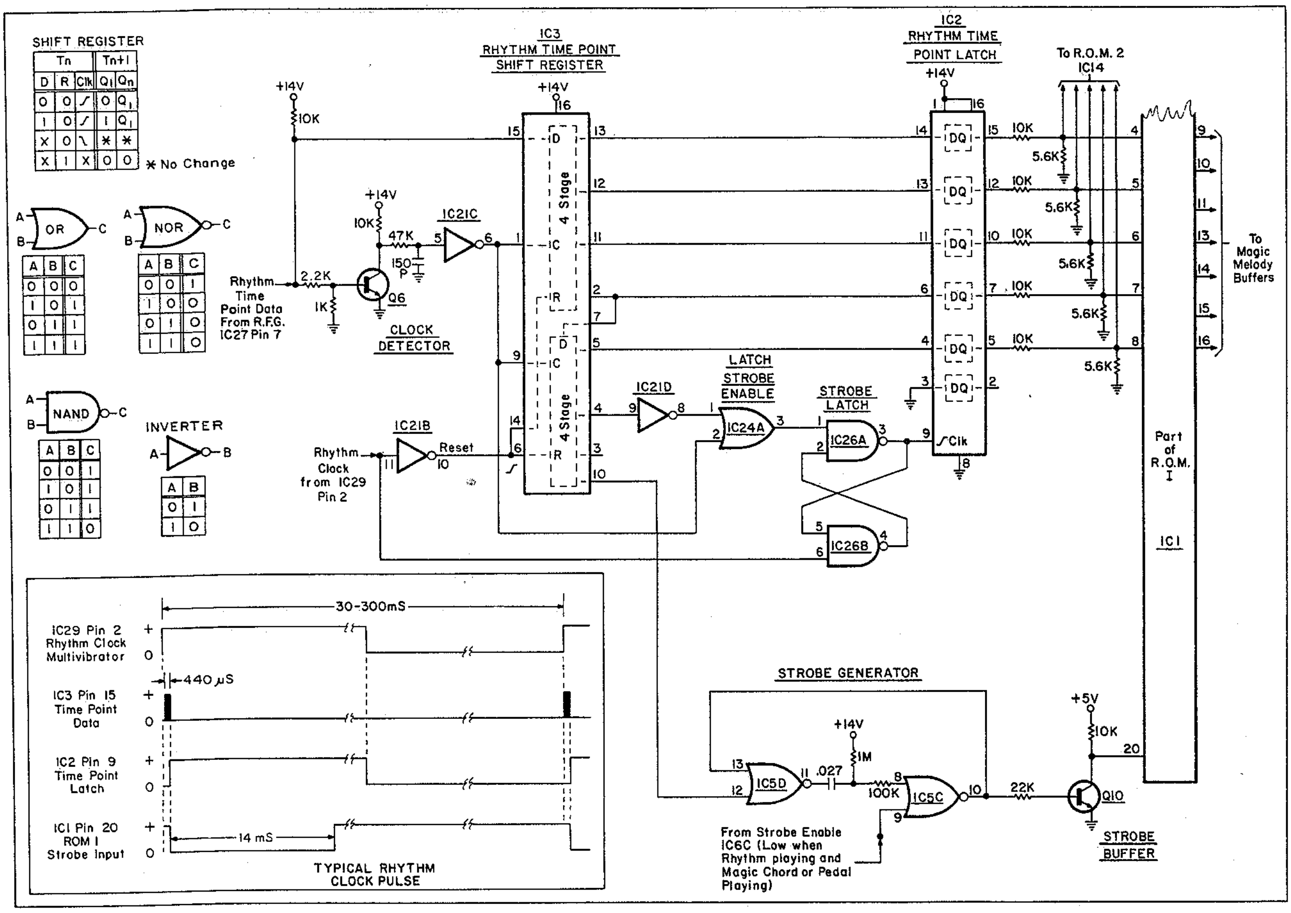

SHIFT REGISTER
Tn
Tn+1
D R Clk Q1 Qn
* No Change
OR
NOR
NAND
INVERTER
IC3
RHYTHM TIME POINT SHIFT REGISTER
+14V
10K
2.2K
1K
47K
150P
Q6
IC21C
CLOCK DETECTOR
Rhythm Time Point Data From R.F.G. IC27 Pin 7
4 Stage
IC21B
Rhythm Clock from IC29 Pin 2
Reset
IC21D
LATCH STROBE ENABLE
IC24A
STROBE LATCH
IC26A
IC26B
IC2
RHYTHM TIME POINT LATCH
DQ
Clk
To R.O.M. 2 IC14
5.6K
To Magic Melody Buffers
Part of R.O.M. I
IC1
30-300mS
IC29 Pin 2 Rhythm Clock Multivibrator
440µS
IC3 Pin 15 Time Point Data
IC2 Pin 9 Time Point Latch
IC1 Pin 20 ROM I Strobe Input
14 mS
TYPICAL RHYTHM CLOCK PULSE
STROBE GENERATOR
IC5D
.027
1M
100K
IC5C
From Strobe Enable IC6C (Low when Rhythm playing and Magic Chord or Pedal Playing)
+5V
22K
Q10
STROBE BUFFER

Fig. 6 - Rhythm Time Point Data Decoding

The audio section consists of a phase-locked loop (PLL) which generates a high frequency signal when an audio frequency (from the Chord Function Generator or bass pedal) is applied to its input. The high frequency is applied to an Octave Synthesizer which generates thirteen audio frequencies. The harmonically related frequencies (Root, third, fifth, sixth and minor seventh) are applied to the Magic Melody Keying Circuits (see Schematic 13). Positive pulses from Read Only Memory 1 (ROM 1) key the audio. The keyed audio is applied to Magic Melody filters where the tonality is developed. The root, second, third, fifth, sixth, seventh and eighth (octave) frequencies are inputted to the Swing Bass Note Select. A three bit note select from ROM 2 selects a bass frequency that will be applied to the Swing Bass circuit.

DEVELOPMENT OF TEN BIT ADDRESS

A ten bit address (combination of ten high/low inputs) is applied to Read Only Memories (ROM) 1 and 2. The two most significant bits (MSB) contain the track select information (Track A, B or C). The next three bits show which of the six rhythm tabs (or Intro) is pressed. The five least significant bits (LSB) show the active time point of the rhythm pattern.

Track Select Decoding
[Two Most Significant Bits]
XX 000 00000

The two most significant bits applied to the ROM identify the track selected. Selecting Track A applies a high (+14 volts) to ROM 1 and ROM 2 Pins 22. A high is applied to ROM 1 and ROM 2 Pins 23 when Track B is selected. Pins 22 and 23 will both be low (zero volts) when Track C is selected.

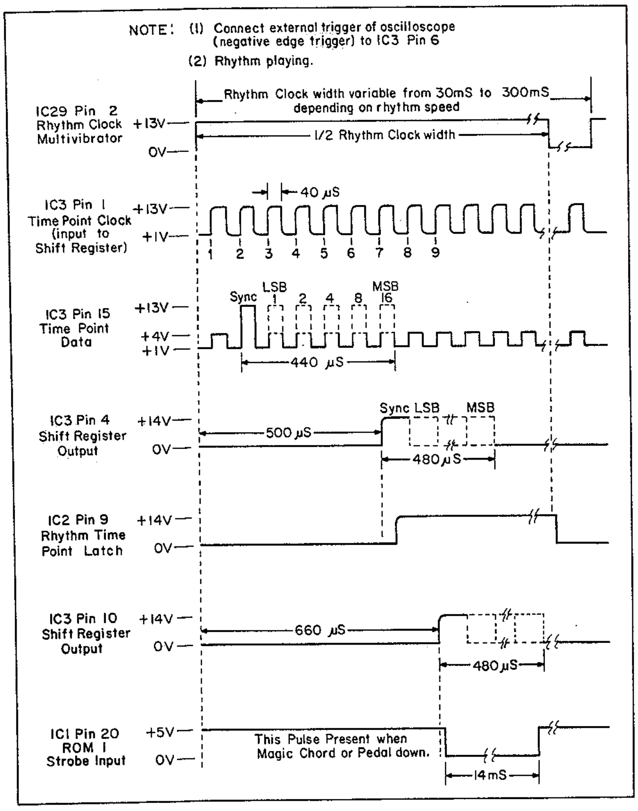

NOTE: (1) Connect external trigger of oscilloscope (negative edge trigger) to IC3 Pin 6
(2) Rhythm playing.
Rhythm Clock width variable from 30mS to 300mS depending on rhythm speed
IC29 Pin 2 Rhythm Clock Multivibrator
+13V
0V
1/2 Rhythm Clock width
40 µS
IC3 Pin 1 Time Point Clock (input to Shift Register)
+13V
+1V
1 2 3 4 5 6 7 8 9
IC3 Pin 15 Time Point Data
+13V
+4V
+1V
Sync
LSB 1
2
4
8
MSB 16
440 µS
IC3 Pin 4 Shift Register Output
+14V
0V
500 µS
Sync LSB MSB
480 µS
IC2 Pin 9 Rhythm Time Point Latch
+14V
0V
IC3 Pin 10 Shift Register Output
+14V
0V
660 µS
480 µS
IC1 Pin 20 ROM 1 Strobe Input
+5V
0V
This Pulse Present when Magic Chord or Pedal down.
14mS

Fig. 7 - Expanded Rhythm Data Timing Diagram

Rhythm Select Decoding
00 XXX 00000

A priority encoder IC15 is used to develop the rhythm tab data. The Intro pattern has the highest priority followed by the rhythm 6 tab. The lowest priority is assigned to the rhythm 1 tab. The input with the highest priority will have a three bit output which is applied to Pins 1, 2 and 3 of ROM 1 and ROM2.

Rhythm Time Point Data Decoding
[Five Least Significant Bits]
00 000 XXXXX
[See Fig. 6]

The Rhythm Function Generator (RFG) contains an internal oscillator which oscillates at a frequency of 12.5KHz. The time point clock frequency is outputted from the RFG at Pin 7. The output at Pin 7 has three logic levels (see Fig.7 - IC3 Pin 15 Time Point Data). The half level output is the 12.5KHz oscillator. The high level output is a sync pulse and when the rhythm is running, the five pulses folowing the sync pulse contain binary encoded rhythm time point data.

The time point clock (TPC) frequency outputted from Pin 7 of the RFG is applied to the Clock Detector Q6. The Clock Detector saturates and cuts off which amplifies the TPC frequency. Inverter IC21C inverts the TPC frequency and applies the clock pulses to the Rhythm Time Point Shift Register IC3 and the Latch Strobe Enable IC24A. (See Fig. 7 IC3 Pin 1 - Time Point Clock.)

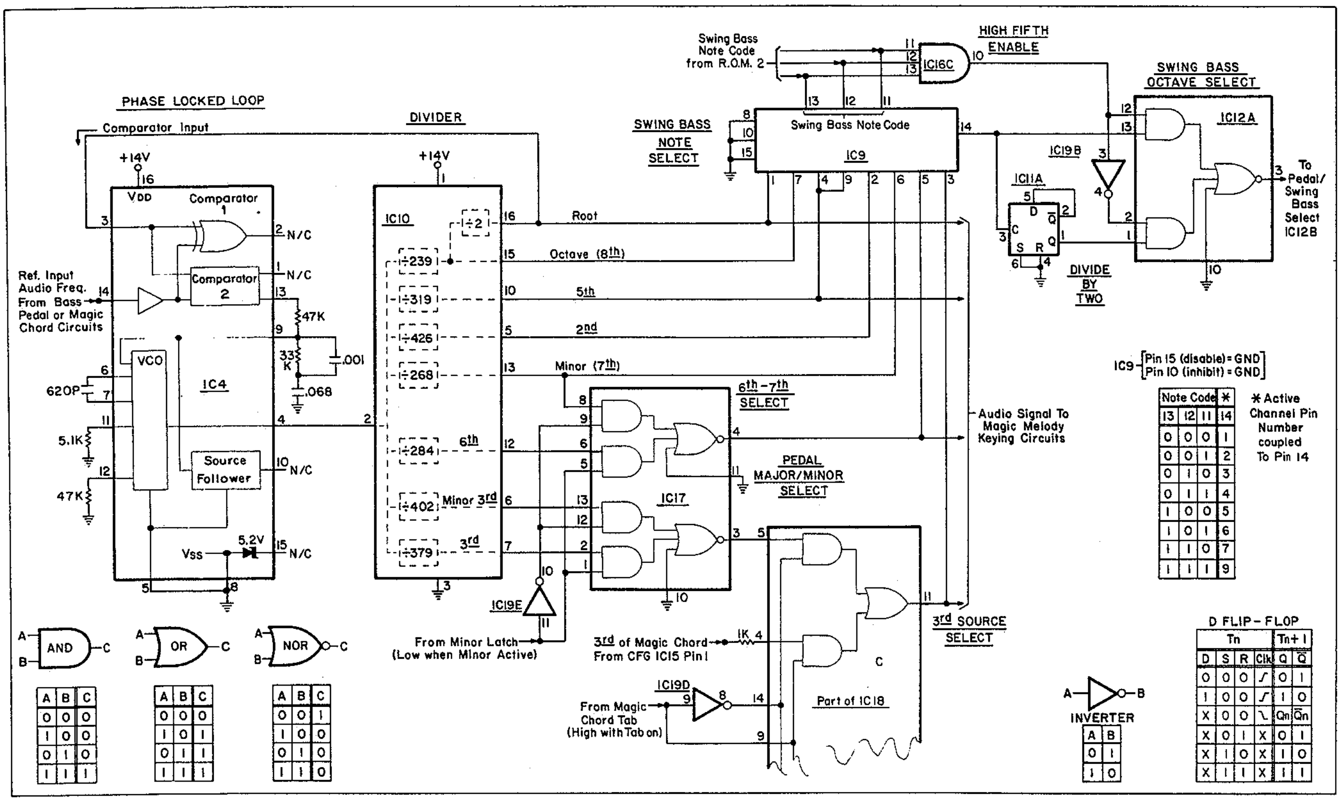
Rhythm time point data is applied to Pin 15 of IC3 (see Fig. 7 - IC3 Pin 15 Time Point Data) when the rhythm is running. The input of IC3 (Pin 3) does not 'see' the half level TPC frequency because the clock pulse amplitude is below the threshold of IC3. Therefore, only data corresponding to the active time point will be clocked into the shift register.
NOTE: The following sequence is completed less than .5 milliseconds after the Rhythm Clock output switches positive. [See Diagram Fig. 6.]

Each time the Rhythm Clock output switches positive, a low is applied (from Inverter IC21B) to the reset input of IC3 enabling IC3. The time point data is clocked into the shift register IC3.

Normally, the output of Inverter IC21D is high. When the sync pulse is shifted to Pin 4 of IC3, the output of IC21D switches low. This low is applied to one input of Latch Strobe Enable IC24A. When the time point clock frequency switches low, the output of IC24A switches low. This toggles Strobe Latch IC26A Pin 3 high, clocking Rhythm Time Point Latch IC2. This latches the time point data into IC2. The least significant bit (LSB) is applied to IC2 Pin 4 and the most significant bit (MSB) is applied to IC2 Pin 14. Once transferred to the Q outputs of IC2, the time point data is applied to Read Only Memories (ROM) 1 and 2 where it becomes part of the ten bit address.

Magic Melody and Swing Bass Keying

The time point data continues to shift through the Rhythm Time Point Shift Register IC3. When the sync pulse shifts to Pin 10 of IC3, a pulse is triggered in the Strobe Generator. If the rhythm is playing and a Magic Chord or Pedal is being played, a positive pulse is outputted from IC5C Pin 10. The positive pulse causes the Strobe Buffer Q10 to saturate. The collector of Q10 switches low which enables ROM 1. When enabled, ROM 1 outputs (in parallel) the eight bit binary word corresponding to the address code applied to the input pins. If an output level is high, a keying pulse is applied through the Magic Melody Buffers Q16-29 to the Magic Melody Keying Circuits or through Swing Bass Keyer Buffer IC8D to the Swing Bass Keyer IC7D.


PHASE LOCKED LOOP
Comparator Input
+14V
VDD
Comparator 1
N/C
Ref. Input Audio Freq. From Bass Pedal or Magic Chord Circuits
Comparator 2
47K
VCO
IC4
.001
620P
.068
5.1K
Source Follower
47K
Vss
5.2V
DIVIDER
IC10
÷2
÷239
÷319
÷426
÷268
÷284
÷402
÷379
Root
Octave (8th)
5th
2nd
Minor (7th)
6th
Minor 3rd
3rd
IC19E
From Minor Latch (Low when Minor Active)
SWING BASS NOTE SELECT
Swing Bass Note Code from R.O.M. 2
IC16C
HIGH FIFTH ENABLE
Swing Bass Note Code
IC9
IC19B
IC11A
DIVIDE BY TWO
SWING BASS OCTAVE SELECT
IC12A
To Pedal/ Swing Bass Select IC12B
IC9 Pin 15 (disable) = GND Pin 10 (inhibit) = GND
Note Code
* Active Channel Pin Number coupled To Pin 14
6th-7th SELECT
IC17
PEDAL MAJOR/MINOR SELECT
Audio Signal To Magic Melody Keying Circuits
3rd of Magic Chord From CFG IC15 Pin1
1K
IC19D
From Magic Chord Tab (High with Tab on)
Part of IC18
3rd SOURCE SELECT
AND
OR
NOR
INVERTER
D FLIP-FLOP

A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

A	B	C
0	0	0
1	0	1
0	1	1
1	1	1

A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

13	12	11	14
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	9

A	B
0	1
1	0

D	S	R	Clk	Q	$\bar{Q}$
0	0	0	↑	0	1
1	0	0	↑	1	0
X	0	0	↓	Qn	$\bar{Q}$n
X	0	1	X	0	1
X	1	0	X	1	0
X	1	1	X	1	1

Fig. 8 - Magic Melody and Swing Bass Audio Frequency Generator

ROM 2 is enabled at all times (because Pin 20 is connected to ground). Each time the time point data changes, the outputs change. ROM 2 has information which selects the snubs for the cymbal and brush rhythm instruments and the Magic Melody Banjo/Piano. The lower keyboard accent is also controlled by ROM 2. Three outputs of ROM 2 (Pins 9, 10 and 11) are decoded by Swing Bass Note Select IC9 to select the pitch of the Swing Bass Note that will be heard.

Q16-29 MAGIC MELODY BUFFERS

Seven of the eight outputs of ROM 1 are connected to the Magic Melody Buffer circuits. Each time an output of ROM 1 is active, it goes positive which causes the transistor (Q16-22) connected to its output to saturate. When this transistor (Q16-22) saturates, it causes the PNP transistor (Q23-29) to saturate applying positive voltage to its corresponding Magic Melody Keying circuit. (See Schematic 13.)

AUDIO

The Magic Melody and Swing Bass tone generator consists of a phase-locked loop and an octave frequency divider. The audio frequencies outputted by the divider are applied to the Magic Melody Keyers and to the Swing Bass Note Select.

IC4 PHASE-LOCKED LOOP [See Fig. 8.]

The reference input to the Phase-Locked Loop (Pin 14) is an audio frequency from either the Pedal Latch or Chord Function Generator. The reference frequency is the root of the chord to be outputted by the Magic Melody and Swing Bass circuits.

The primary components of the phase-locked loop are a comparator and a voltage controlled oscillator (VCO). One input to the comparator is the reference frequency. The other comparator input (Pin 3) is the root pitch of the Octave Frequency Divider IC10. When the frequency at Pin 3 is not equal to the reference frequency, comparator 2 outputs a voltage which changes the frequency of the VCO until it generates a frequency which makes the frequency and phase of the signal at Pin 3 the same as the reference at Pin 14.

IC10 DIVIDER [See Fig. 8]

The Divider, IC10, is an octave frequency synthesizer. When a reference frequency is applied to the phase-locked loop, the Divider generates the same frequency (root) and the twelve notes above it. These audio frequencies are applied to the Magic Melody keyers and to the Swing Bass Note Select IC9. When the rhythm is running, keying voltage from Read Only Memory (ROM) 1 selects the Magic Melody notes that will be heard. ROM2 outputs a three bit code that selects the Swing Bass note that will be keyed.

NOTE: When there is no reference frequency input to the PLL, the VCO outputs a low frequency.

IC17 6TH - 7TH SELECT [See Fig. 8]

Normally, Pin 5 of IC17 is high. This enables the sixth of the octave to be outputted. When the Minor Footswitch is pressed, Pin 5 is applied low and Pin 9 is applied high. This enables the minor seventh of the octave to be outputted. Therefore, Magic Melody and Swing Bass patterns that key the sixth of an octave, will key the minor seventh when the minor footswitch is pressed.

IC17 PEDAL MAJOR MINOR SELECT [See Fig. 8]

Normally, Pin 1 of IC17 is high. This enables the third of the octave to be outputted. When the Minor Footswitch is pressed, Pin 1 is applied low and Pin 12 is applied high. This enables the minor third of the octave to be outputted. The third or minor third pitch is applied to Pin 5 of Third Source Select, IC18.

IC18C THIRD SOURCE SELECT [See Fig. 8]

When the Magic Chord tab is off, Pin 14 of IC18 is high enabling the signal at Pin 5 of IC18 (from IC17 Pin 3) to pass through IC18 to Pin 11. Turning on the Magic Chord tab applies a low to Pin 14 and a high to Pin 9 enabling the third/minor third output of the CFG to pass to the output of IC18.

IC9 SWING BASS NOTE SELECT [See Fig. 8]

The Swing Bass Note Select IC9 is an eight channel data selector. A three bit code is applied to Pins 11, 12 and 13 from ROM 2. The code selects the pitch that will be outputted from IC9. (See Truth Table Fig. 8). The selected note is applied to a divider and to Swing Bass Octave Select IC12A.

IC11A DIVIDE-BY-TWO DIVIDER [See Fig. 8]

The selected Swing Bass note is applied to IC11A where the audio frequency is divided in half. The divided swing bass audio is applied to Swing Bass Octave Select IC12A.

IC12A, IC16C SWING BASS OCTAVE SELECT, HIGH FIFTH ENABLE [See Fig. 8]

Normally, Pin 12 of IC12A is low and Pin 2 is high. This enables the divided Swing Bass audio to pass through IC12A. When the three bits of the Swing Bass Note code are high (all ones), the fifth note of the octave is selected. The three inputs to High Fifth Enable IC16C will be high and its output will switch high. This high is applied to Pin 12 of IC12A and inverted to a low through IC19B and applied to Pin 2. This enables the fifth of the octave to pass through IC12A without being divided. The signal output of IC12A is applied to Pedal/Swing Bass Select IC12B.

IC12B, IC11B PEDAL/SWING BASS SELECT, DIVIDER

When the Swing Bass Tab is off, Pin 8 of IC12B is low and Pin 5 is high (through Inverter IC19C). This enables the pedal bass audio to be applied to Divider IC11B. When the Swing Bass is enabled, Pin 8 will be high and Pin 5 will be low (through Inverter IC19C). This enables the Swing Bass audio to pass to Divider IC11B. The audio outputted by IC11B is applied to the 8-foot Pedal Divider IC9B (see Schematic 14).

IC19C, Q11 PEDAL SUSTAIN, SWING BASS SNUB SWITCHER

Pin 6 of IC19C is high when the Swing Bass tab is off. Pressing the Pedal Sustain tab applies this voltage through D1 to the cathode of D34 (see Schematic 14). This reverse biases D34 which, in effect, opens the discharge path for the pedal sustain capacitor. The capacitor discharges onto the base of Swing Bass/Pedal Driver transistor Q25 creating a sustain effect.

Enabling the Swing Bass applies a high to the input of IC19C which switches its output low disabling pedal sustain. The high level is applied through a 22K resistor to both the Swing Bass Snub Switcher Q11 and through Diode D2 to Swing Bass/Pedal Driver Q25 (see Schematic 14). When ROM 2 outputs a positive pulse at Pin 13, Q11 saturates which grounds the voltage applied to Q25. This permits the sustain capacitor to discharge through D34 which gives staccato to the Swing Bass.

IC18A PHASE-LOCKED LOOP REFERENCE SELECT

This section of IC18 selects audio from either the pedal bass (IC10 Pin 4) or Chord Function Generator (IC15 Pin 40). This permits the Magic Melody and Swing Bass to be keyed from the bass pedals or from the Magic Chord keys when the Magic Chord tab is on.

Q13-15 GENIE KEYDOWN DETECTOR

Each time a Magic Chord Key is pressed, positive voltage is applied to the emitter of Q13. The emitter of Q13 becomes more positive than the base and Q13 cuts off. When Q13 cuts off, a positive pulse is developed across a .01uf capacitor which causes Q14 to momentarily saturate. Transistor Q15 cuts off and applies a positive pulse to Latch Reset Source Select IC18B.

IC18B LATCH RESET SOURCE SELECT

This section of IC18 selects the source of reset pulses to be applied to the Minor Latch IC5A&B. A pulse from the Pedal Latch IC5 is inverted by IC25C and applied through IC18B to the Minor Latch unless the Magic Chord tab is on. When the Magic Chord tab is on, reset pulses are applied from the Genie Keydown Detector through IC18B to the Minor Latch.

IC5A&B MINOR LATCH

The Minor Latch is a set/reset flip-flop. When the Minor footswitch is pressed, positive voltage is applied to Pin 1 of IC5A. Its output Pin 3 switches low. The low disables the third and sixth outputs of the octave synthesizer Divider IC10. The low is inverted by IC19E and enables the minor third and minor seventh outputs of IC10. When a new pedal or Magic Chord Keyswitch is pressed, a pulse is applied to Pin 6 of IC5B which resets Pin 3 high.

IC16A RHYTHM & MAGIC CHORD 'ON' DETECTOR

All three inputs to IC16A must be high before Pin 9 (output) will switch high. Pin 9 will be high only when a rhythm is playing and the Magic Chord tab is off. This enables the Pedal Down Latch IC26C&D.

IC26C&D PEDAL DOWN LATCH

When a bass pedal is pressed, a low is applied to IC26C Pin 8 switching its output Pin 10 high. Pin 12 goes high because Pin 10 is high. When Pin 13 (enable) is high, the output of IC26D switches low. This low is applied back to IC26C Pin 9 latching Pin 11 low. This low level is applied to one input of Chord/Pedal Down Detector IC13A. IC26D Pin 11 will be reset high when the rhythm is not playing or the Magic Chord tab is pressed. Pin 11 is reset high at power turn on.

IC13A CHORD/PEDAL DOWN DETECTOR

The output of the Pedal Down Latch is applied to Pin 1 of IC13A. Pin 1 will be low when the following conditions are met:

1) The Magic Chord tab is off
2) The Rhythm is running
3) A bass pedal is pressed.

The input to Pin 2 of IC13A is from the Chord Function Generator Pin 3. When the Magic Chord tab is off, IC13A Pin 2 will be high. When the Magic Chord tab is on and a Magic Chord is being played, the CFG Pin 3 outputs an audio signal. Diode D5 and the .022 uf capacitor rectify the audio into a low level.

When one of the inputs to IC13A is low, its output Pin 3 switches low. This is applied to Strobe Enable IC6C.

IC6C STROBE ENABLE

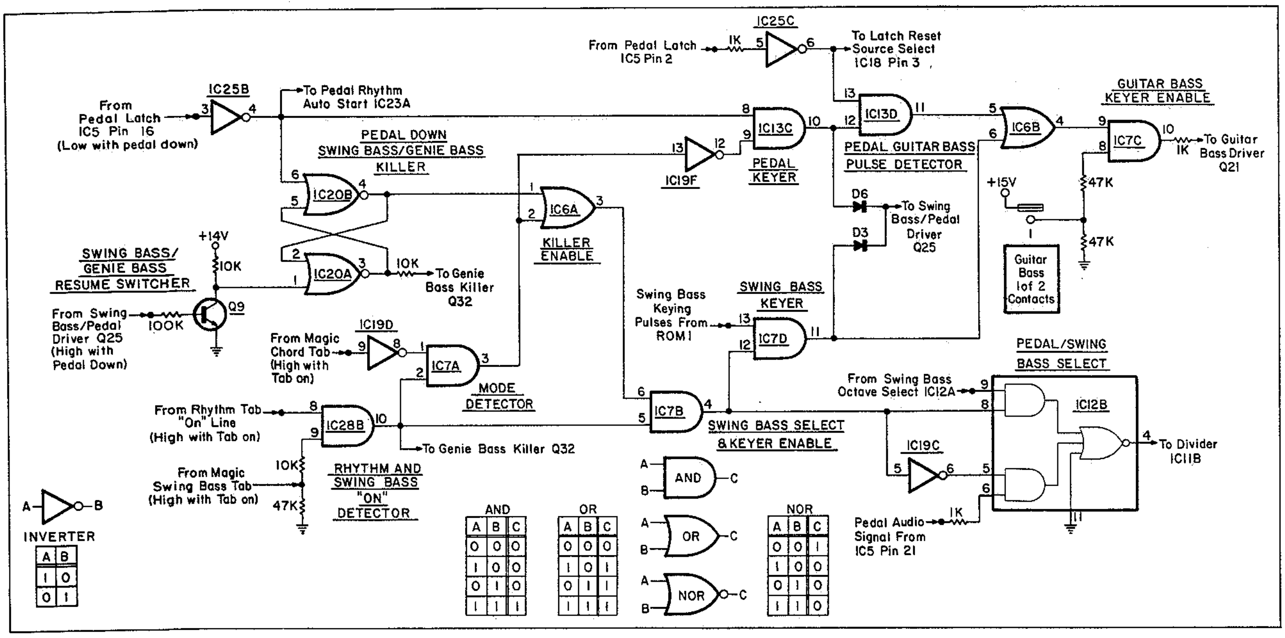
The Strobe Generator is enabled when Pin 9 of IC5C is low. Pin 9 will be low when the rhythm is playing and either a bass pedal or Magic Chord is played.

Genie Bass Killer
[See Fig. 9]

Q9, IC20A&B SWING BASS/GENIE BASS RESUME SWITCHER, KILLER

The lower keyboard Swing and Magic Genie bass are cancelled when a bass pedal is pressed. IC20A&B forms a Set/Reset Flip-Flop. Pin 1 of IC20A is normally high which keeps Pin 3 reset low. When a bass pedal is pressed, positive voltage is applied to Q9 causing it to saturate and switch Pin 1 low. The output of the Pedal Latch is inverted to a high by IC25B and applied to Pin 6 of IC20B. This "sets" Pin 3 of IC20A high. This positive voltage is applied to the Genie Bass Killer Q32 (see Schematic 14) grounding the Genie Bass keying voltage. Releasing the bass pedal removes the voltage from the base of Q9. Q9 cuts off applying a high to IC20A Pin 1 resetting Pin 3 low.

CIRCUIT DESCRIPTION



IC25C
From Pedal Latch IC5 Pin 2
1K
5
6
To Latch Reset Source Select IC18 Pin 3
IC25B
From Pedal Latch IC5 Pin 16 (Low with pedal down)
To Pedal Rhythm Auto Start IC23A
PEDAL DOWN SWING BASS/GENIE BASS KILLER
IC20B
IC20A
SWING BASS/ GENIE BASS RESUME SWITCHER
+14V
10K
10K
To Genie Bass Killer Q32
From Swing Bass/Pedal Driver Q25 (High with Pedal Down)
100K
Q9
IC19D
From Magic Chord Tab (High with Tab on)
IC7A
MODE DETECTOR
IC6A
KILLER ENABLE
From Rhythm Tab "On" Line (High with Tab on)
IC28B
To Genie Bass Killer Q32
From Magic Swing Bass Tab (High with Tab on)
10K
47K
RHYTHM AND SWING BASS "ON" DETECTOR
IC19F
IC13C
PEDAL KEYER
IC13D
PEDAL GUITAR BASS PULSE DETECTOR
D6
D3
To Swing Bass/Pedal Driver Q25
Swing Bass Keying Pulses From ROM1
SWING BASS KEYER
IC7D
IC7B
SWING BASS SELECT & KEYER ENABLE
From Swing Bass Octave Select IC12A
PEDAL/SWING BASS SELECT
IC12B
To Divider IC11B
IC19C
Pedal Audio Signal From IC5 Pin 21
IC6B
+15V
Guitar Bass 1of 2 Contacts
47K
47K
GUITAR BASS KEYER ENABLE
IC7C
1K
To Guitar Bass Driver Q21
A B INVERTER
A B: 1 0; 0 1
AND
A B C: 0 0 0; 1 0 0; 0 1 0; 1 1 1
OR
A B C: 0 0 0; 1 0 1; 0 1 1; 1 1 1
NOR
A B C: 0 0 1; 1 0 0; 0 1 0; 1 1 0

Fig. 9 - Pedal/Swing Bass Keying Source Select

Swing Bass Killer [See Fig. 9]

IC7A, IC6A MODE DETECTOR, KILLER ENABLE When the Magic Chord tab is on, the output of Mode Detector IC7A Pin 3 will be low. When a bass pedal is pressed, Pin 4 of IC20B switches low. Because both inputs to Killer Enable IC6A are low, its output switches low which disables the Swing Bass Keyer IC7D (through IC7B) and switches Pedal/Swing Bass Select IC12B to the Pedal Bass position. When the bass pedal is released, IC20B Pin 4 is reset high enabling the Swing Bass to resume.

BASS PEDAL KEYING [See Fig. 9]

Pressing a bass pedal applies a low to IC25B which inverts the low to a high level. This high level triggers the Rhythm Auto Start (if a rhythm tab and the Auto Start tab are pressed) and is applied to the Pedal Keyer IC13C Pin 8. If the Swing Bass tab is off, Pin 9 of IC13C is high and the voltage applied to Pin 8 is outputted at Pin 10 and applied to Swing Bass/Pedal Driver Q25 (see Schematic 14) keying the pedal bass audio.

Pedal Guitar Bass [See Fig. 9]

The Pedal Latch outputs a pulse at pedal keydown which is inverted to a positive pulse by IC25C. This pulse is passed through IC13D Pedal Guitar Bass Pulse Detector and OR gate IC6B to Pin 9 of Guitar Bass Keyer Enable IC7C. When the Guitar Bass tab is on, the pulse is passed through IC7C and applied to Guitar Bass Driver Q21 (see Schematic 14).

SWING BASS KEYING [See Fig. 9]

The Swing Bass may be keyed from either the bass pedals or lower keyboard depending on the position of the Magic Chord tab.

When a rhythm tab and the Magic Swing Bass tab are on, the output of Rhythm and Swing Bass 'On' Detector IC28B will be high. This high level performs three functions.

1) It disables the Genie (keyboard) bass by causing Q32 to saturate (see Schematic 14).
2) It applies a high level to Mode Detector IC7A Pin 2. If the Magic Chord tab is off, Pin 1 of IC7A will be high and the output, Pin 3, of IC7A will go high. This high is applied through Killer Enable IC6A to Pin 6 of Swing Bass Select and Keyer Enable IC7B. This high also disables Pedal Keyer IC13C.
3) It applies a high to Pin 5 of IC7B. Because both inputs to IC7B are high, its output switches high and enables the Swing Bass Keyer IC7D and selects the Swing Bass Audio Input to Pedal/Swing Bass Select IC12B.

When the above conditions are met, pulses from Read Only Memory 1 Pin 17 are applied through IC7D Swing Bass Keyer to Swing Bass/Pedal Driver Q25 (see Schematic 14). When the Guitar Bass tab is on, Swing Bass Keyer Pulses are passed through IC7C Guitar Bass Keyer Enable and applied to the Guitar Bass Driver Q21. (See Schematic 14.)

SCHEMATIC 13

MAGIC MELODY KEYING AND FILTERING

IC7, IC8 MAGIC MELODY DIVIDERS

The audio frequencies outputted by the Octave Synthesizer Divider IC10 are applied to the cathodes of keying diodes (D18, D21 and D3) and the clock inputs of dividers IC7A, 7B, 8A and 8B where the frequency is divided in half and applied to the cathodes of keying diodes D12, D15, D6 and D9). When the rhythm is running and Read Only Memory 1 is enabled (see Schematic 12), positive pulses are applied to the anodes of the keying diodes in a sequence determined by the selected rhythm to key the Magic Melody notes. The divided-by-two pitches are referred to as low octave Magic Melody notes.

Q20 BANJO/PIANO SNUB SWITCHER

Positive pulses outputted by ROM 2 at various time points cause Q20 to saturate. This provides a discharge path for the 2.2uf sustain capacitors located on each keying line creating a staccato effect for the Magic Melody Banjo and Piano voices at certain time points (see Rhythm Timing Diagrams).

Q2 STRING SNUB CANCEL SWITCHER

Turning the Magic Melody String tab on applies positive voltage to the base of Q2 causing this transistor to saturate. This cuts off Q20 which removes the discharge path for the 2.2uf sustain capacitors. This gives the Magic Melody Strings a sustain effect.

IC6A MAGIC MELODY MIXER

The keyed Magic Melody audio signals are applied to the Magic Melody Mixer before being routed to the banjo, piano and string filters.

Q5, Q7 BANJO, PIANO, STRING FILTERS

Active filters are used for the banjo and piano voices. The string filter is passive. The filters develop the tonality of the voice by passing a band of frequencies. The outputs of the filters are applied to FET switchers.

Q4, Q6, Q8 STRING, BANJO AND PIANO SWITCHERS

The FET switchers are pinched off when the voltage at the gate is less than the voltage at the drain and source. When the tab associated with a switcher is turned on, positive voltage is applied to the gate causing the FET to be gated on and pass the audio signal to the preamps.

IC6D MAGIC MELODY BANJO AND PIANO PREAMP

The Magic Melody banjo and piano audio signals are amplified by IC6D before being routed to the output mixer via the Magic Melody Volume Control.

IC5D MAGIC MELODY STRING PREAMP

The Magic Melody string audio signals are amplified by IC5D before being routed to the output mixer via the Magic Melody Volume Control.

SCHEMATIC 14

BASS FILTERING

IC9B, IC9A DIVIDERS

The Pedal Bass or Swing Bass audio signals are applied to Divider IC9B where the frequency is divided to an eight foot pitch. IC9A divides the eight foot audio to a sixteen foot pitch.

Q25 SWING BASS/PEDAL DRIVER

Keying voltage from either the Bass Pedals or Swing Bass circuits (see Schematic 12) is applied to the base of Driver Q25 causing this transistor to saturate. When Q25 saturates it applies keying voltage to D36 and 16 foot Pedal Keyer Q24 and to D35 and 8 foot Pedal & Swing Bass Keyer Q26. Diode D34 is part of the sustain circuit for Q25. When D34 is reverse biased, the .1uf capacitor will discharge onto the base of Q25 when the bass pedal is released (or after the Swing Bass keying pulse). If there is no voltage present at the cathode of D34 and the keying voltage is removed from the base of Q25, then the .1uf sustain capacitor will discharge through D34 and the 1 Megohm resistor giving no sustain. When Q25 cuts off (after pedal release and sustain capacitor discharge) the Resume Switcher Q9 (see Schematic 12) cuts off enabling the keyboard bass.

Q24 16-FOOT PEDAL KEYER

Positive keying voltage from Q25 forward biases diode D36 applying 16 foot audio to Keyer Q24. The signal outputted at the emitter of Q24 is applied to the 16 foot Filter Q36 when the Pedal 16'-8' tab is on.

Q26 8 FOOT PEDAL & SWING BASS KEYER

Positive keying voltage from Q25 forward biases diode D35 applying 8-foot audio to Keyer Q26. The signal outputted at the emitter of Q26 is applied via 8'/16' switchers to the 8-foot Filter and through resistors to the 16-foot Filter and Guitar Bass Filter.

Q34, Q35 8'/16' SWITCHERS

When the Pedal 16-8 tab is off, the 8 foot Bass audio is enabled. Positive voltage from the off buss of the Pedal 16-8 tab is applied:

1) to the reset input of IC9A 16' Pedal Divider, disabling the divider.
2) to the base of Switcher Q35 causing this transistor to saturate which grounds the input to the 16' Filter.
3) to the base of Switcher Q34 causing this transistor to saturate. This applies the 8' Pedal audio to the 8' Filter.

When the Pedal 16-8 tab is on:

1) the reset input of IC9A 16' Pedal Divider is switched low enabling the divider to output 16' audio signal.
2) Switcher Q35 is cut off, removing ground from the input to the 16' Filter.
3) Switcher Q34 is cut off, disconnecting the 8' Pedal audio from the 8' Filter. The 8' Pedal audio is applied through a resistor to the 16' Filter.

NOTE: If the Pedal 16-8 tab is on and the Magic Swing Bass tab is turned on, the Pedal Keying circuit is switched to the 8' Bass configuration [see above].

Q21, Q22 GUITAR BASS DRIVER, KEYER

When the Guitar Bass tab is on, positive pulses from the Swing Bass Keyer or Pedal Guitar Bass Pulse Detector (see Schematic 12) are applied to the bass of Guitar Bass Driver Q21. When Q21 turns on, it applies a positive pulse to Guitar Bass Keyer Q22, turning it on. Applied to the base of Q22 is 8' pedal audio. When Q22 turns on, the 8' pedal audio is applied as a pulse to the Guitar Bass Filter.

Q29 GENIE BASS DRIVER

When the rhythm is playing, the Rhythm Function Generator outputs a sequence of pulses. These pulses are gated through a Pulse Detector IC9A and an Audio Detector IC9B (see Schematic 15) and applied to the base of Genie Bass Driver Q29. When Q29 turns on, it applies positive voltage to Genie Bass Keying Diode D33 and to the base of Genie Bass Keyer Q30. Diode D33 becomes forward biased which applies Genie Bass audio signal to Q30. The output of Q30 is applied to the 8' Filter and to the Guitar Bass Filter Q23 when the Guitar Bass tab is on.

Q32 GENIE BASS KILLER

Genie Bass Killer Q32 is normally saturated which grounds the output of Genie Bass Driver Q29. When the Genie String Bass or Magic Swing Bass tabs are switched on, Q32 cuts off enabling Genie Bass Keyer Pulses to reach the Genie Bass Keyer Q30. When a Bass Pedal is pressed, positive voltage from Pedal Down Genie Bass Killer IC20 Pin 3 (see Schematic 12) saturates Q32 disabling the Genie Bass. If the Magic Swing Bass tab and a rhythm tab are on, Q32 will saturate disabling the Genie Bass.

Q36, Q31, Q23 16', 8' & GUITAR BASS FILTERS

These active low-pass filters remove higher harmonics from the audio signal and develop the tonality for the 16' and 8' string bass and guitar bass voices.

Q27, Q28 BASS VOLUME SWITCHERS

When the Bass Volume tabs are off, Q27 and Q28 are saturated. A voltage divider is formed between the output coupling resistor of each filter and a 1.3K resistor to ground (through Q27). Resistors are added to the voltage divider when the Bass Medium or Bass Full tab is switched on, raising the junction at the input to the Bass Mixing Preamp higher above ground. This increases the signal level applied to the Bass Mixing Preamp, increasing the bass volume.

IC6B BASS MIXING PREAMP

The outputs of the 16', 8' and Guitar Bass Filters are mixed and amplified by IC6B. The output of IC6B is applied to the Output Mixer (see Schematic 17).

SCHEMATIC 15

CFG, SOLO GENERATOR and PEDAL LATCH

Three major circuits are shown on Schematic 15. These are the Chord Function Generator (CFG), Solo Generator, and the Pedal Latch. All three circuits share common components.

IC7 CFG/PEDAL OSCILLATOR

The CFG/Pedal Oscillator IC7 generates 500KHz which is applied directly to the Pedal Latch. The CFG/Pedal Oscillator frequency is divided in half (250KHz) and applied to the CFG. The CFG/Pedal Oscillator frequency is divided by eight (62.5KHz) and becomes the scan clock for the Solo Generator and the Magic Genie 4' and AOC Decoder.

NOTE: When the vibrato tab is on, the bass pedals and CFG features will have a vibrato effect. If a rhythm tab is turned on the output from the vibrato oscillator is grounded, cancelling vibrato of the Lower Keyboard Genie and pedal bass features.

MAGIC GENIE

IC15 CHORD FUNCTION GENERATOR

The Chord Function Generator IC15 contains a keyboard scanning system, five programmable frequency generators and the required logic to provide four output features which are bass, chord, strum and arpeggio.

NOTE: The strum, arpeggio and Boogie Woogie Bass keying functions of the CFG are not enabled and therefore not outputted from the CFG. The chord hold feature is latched in the on position. This enables the chord to continue to play after the Magic Chord key is released.

The 500KHz output of the CFG/Pedal Oscillator is divided-by-two by IC16B and applied to the CFG. This 250KHz signal is applied to five programmable frequency generators via Pin 24 of the CFG. The programmable generators are each capable of generating one of 12 frequencies, dependent on the address code provided them. These generators supply the audio signal for the Magic Chords, Strum and Arpeggio features in the chord mode of the CFG and the bass in both the chord and non-chord modes of the CFG.

The Magic Genie keyboard scanning system is capable of scanning 72 time points on a sequential basis. The scan matrix is partitioned in a 12 (X scan) by 6 (Y scan) array. Sequential pulses are outputted on the 12 'X' lines and a particular time point is active when one of the X lines is connected to one of the Y lines. The X scan outputs are normally high and go low when active.

NOTE: The X scan output of the CFG is used to develop the scan matrix for the Solo Generator.

In the non-chord mode (Magic Genie Chord tab off) the High/Low bass feature is the only function that is enabled. In this mode of operation, bass signal is outputted from Pins 6 and 7 of the CFG corresponding to the highest and lowest keyswitches (A1-C3) pressed.

In the chord mode (Magic Genie Chord tab on) circuitry is enabled to add data bits. These bits correspond to the notes in the chord being played. For example, if a chord is being played there will be data bits at 3 of the 72 time points (as observed at Pin 23). If the A2 Key (which is the 7th switch) is pressed, a fourth data bit is added to the chord; pressing the minor footswitch shifts the data at one of the time points creating the minor of the chord being played. The minor and 7th of the chord reset with each new keydown. The bass signal outputted at Pins 6 and 7 correspond to the fifth and root of the chord.

The root (Pin 40), third (Pin 1) and seventh (Pin 3) audio outputs are used to interface the CFG with the Magic Melody and Swing Bass Logic circuitry (see Schematic 12).

There are 28 Lower Keyboard Scan Keyswitches. The first twelve of these are Magic Chord keyswitches. Turning on the Magic Chord tabswitch performs five functions:

1) Pin 13 of IC25D Magic Chord Enable is switched high. This electrically disconnects Pin 29 from Pin 21 of the CFG which places the CFG in the chord mode of operation.
2) Pin 9 of IC12C Serial Data Enabler is switched high enabling serial data to be applied to the AOC Decoder.
3) Pin 2 of A2 Scan Disable IC25A is switched high which prevents keying the A2 scan keyswitch.
4) The A1-G#1 DC keyswitches are disabled by grounding these DC keyswitches through Q111 (see Schematic 3).
5) The Magic Melody and Swing Bass Logic circuitry is switched to the Magic Chord mode.

Pressing a Magic Chord keyswitch (A1-G#1) connects a Y scan line to an X scan line, causing data bits to appear at three CFG time points (four with seventh enabled). These data bits provide the address code for the programmable frequency generators, causing three (or four) audio frequencies that form a specific chord to be outputted at Pin 5 of the CFG. These audio signals are applied to the Magic Chord Preamp. The root (Pin 40) becomes the reference input to the Magic Melody and Swing Bass Phase-locked Loop. The third (Pin 1) becomes part of the Magic Melody and Swing Bass pattern. The seventh (Pin 3) is rectified into a DC voltage and used to enable ROM 1 (see Schematic 12). The Genie Bass Root and Fifth signals are outputted at Pins 7 and 6.

NOTES:

1) In the Magic Chord mode of operation, only the highest chord being played will sound.

2) All the features are outputted when a key is pressed. The chord hold function is enabled whenever the Magic Chord tab is on. This causes the chord data to latch and continue outputting the features after a Magic Chord key is released.

3) The 7th, Minor, Chord Hold, Magic Chord and Any Rhythm On features of the CFG are inverse functions. This means that the time points for these functions are active when the feature is not playing. To enable these functions to operate, the X and Y lines associated with them must be disconnected.

4) Diode D37 connects the X5 scan (CFG Pin 32) to the Y6 line (CFG Pin 21). This diode enables the audio outputs at Pins 1, 3 and 40 to have a 4' pitch. This four foot pitch provides the proper reference frequency to the Magic Melody and Swing Bass Phase-locked Loop.

IC25D MAGIC CHORD ENABLE

When Pin 13 of IC25D is low (Magic Genie Chord tab off), the X scan (Pin 29) is connected to the Y scan (Pin 21) disabling the Magic Chord function of the CFG. Placing the Magic Chord tab in the on position applies positive voltage to Pin 13 of IC25D. This holds Pin 11 (output) high. The Y scan line does not feel the negative transition of the X scan line from Pin 29. This places the CFG in the Magic Chord Mode of operation.

IC24D MINOR ENABLE

The low level at Pin 12 of IC24D connects the X10 scan line (CFG Pin 27) to the Y6 scan line (CFG Pin 21). When the Minor Footswitch (right side of the expression pedal) is momentarily pressed, a positive voltage holds Pin 12 of IC24D high. This momentarily disconnects the X and Y lines and causes the CFG to internally shift a chord data bit which corresponds to the minor of the chord being played. The minor chord will continue to play until either the same or a new Magic Chord key is pressed. The new chord will reset the function back to a major chord.

IC24C 7TH ENABLE

The X11 scan line (CFG Pin 26) is connected to the Y6 scan line through IC24C (due to the low at Pin 9 of IC24C). Momentarily pressing the lower keyboard A2 keyswitch applies a positive voltage to Pin 9 of IC24C. This disconnects the X and Y lines and causes the CFG to internally add a fourth data bit which adds the seventh note to the Magic Chord being played. The seventh chord will continue to play until either the same or a new Magic Chord key is pressed. The new chord will reset the function back to a major chord.

IC25C ANY RHYTHM ON GATE

The X6 scan line (CFG Pin 31) is connected to the Y6 scan line through IC25C (due to the low at Pin 8 of IC25C). When any rhythm tab is pressed, positive voltage is applied to Pin 8 of IC25C. This disconnects the X and Y lines which unlocks the internal bass multiplexer.

IC25B AUTO STOP CHORD HOLD DISABLE

The X9 scan line (CFG Pin 28) is disconnected from the Y6 scan line because Pin 6 of IC25B is high. When the rhythm is stopped (in the Auto position) Pin 6 of IC25B will be low, connecting the X and Y lines, disabling the Chord Hold feature.

Q1 MAGIC CHORD PREAMP

The chord signal outputted at Pin 5 of the CFG is applied through Chord Level Adjust VR1 to the base of Q1. This transistor amplifies the chord signal and applies it to the lower keyboard flute and string filters (see Schematics 5 and 6).

GENIE BASS

HIGH/LOW BASS

With the Magic Genie Chord tabswitch off, the only feature of the CFG chip that is outputted is the High/Low Bass. In this mode of operation, holding down two or more lower keyboard keyswitches (A1-C3) causes the following: audio signal corresponding to the highest note being played is outputted from Pin 6 of the CFG and audio signal corresponding to the lowest note being played is outputted from Pin 7 of the CFG. The high bass signal is routed to Pin 12 of the High/Low Bass Select IC10A and the Low bass signal is routed to Pin 2 of IC10A.

ROOT/FIFTH BASS

With the Magic Genie Chord tabswitch on, the bass feature of the chip is in the Root/Fifth mode of operation. If a Magic Genie Chord (one-note chord) is held at this time, the audio signals at the bass root output (Pin 7) and bass 5th output (Pin 6) are the root and 5th components of the chord being played. The 5th bass signal is routed to Pin 12 of IC10A. The root bass signal is routed to Pin 2 of IC10A.

NOTE: With the rhythm tabs turned off, only the Low/Root bass will be heard.

IC10A, IC16A HIGH/LOW BASS SELECT, DIVIDER

The High/Low Bass Select IC10A has as its inputs at Pins 12 and 2 the high/fifth bass and the low/root bass from Pins 6 and 7 of the CFG. When all rhythms are off, Pin 1 of IC10A is held high and Pin 13 is held low. This enables only the Low/Root Bass signal to be outputted from IC10A. Turning on a rhythm tab causes the inputs at Pins 1 and 13 to alternately switch high and low. The audio output at Pin 3 of IC10A will now be an alternating high/low signal. The audio signal applied to IC16A is frequency divided in half then applied to the Genie Bass Keyer Q30 (see Schematic 14).

IC9A, IC9B PULSE DETECTOR, AUDIO DETECTOR

Pulse Detector IC9A is enabled when a rhythm tab is on. When the rhythm is playing, Bass Keyer Pulses are outputted by the RFG. Each positive pulse is inverted through IC9A and applied as a low to Audio Detector IC9B. Pin 3 of IC9B is normally high. When Genie Bass audio is outputted by the CFG, Diode D8 rectifies the audio signal into DC voltage. Audio Detector IC9B (Pin 3) senses this as a low. Since both inputs are low, IC9B outputs a positive pulse. This pulse is applied to the Genie Bass Driver (see Schematic 14).

BASS PEDALS

IC5 PEDAL LATCH

The CFG/Pedal Oscillator IC7 applies 500KHz directly to the Pedal Latch IC5. The Pedal latch contains the required logic to generate five octave frequencies (1, 2, 4, 8, 16) corresponding to the pedal that is pressed. The Pedal Latch has a low note priority. This enables the lowest pedal (farthest to the left) to have an output when two or more pedals are pressed together. Once a pedal is pressed and released, the audio outputs remain until a new pedal is pressed. The pedal keyswitch inputs are normally high (+14.5 volts) and go low (ground) when active. Each time a pedal is pressed, a negative going pulse is outputted at Pin 2. The output at Pin 16 switches low for the duration of the pedal down.

A capacitor is connected to each pedal keyswitch input (Pins 3-15). The pull-up resistor at Pin 15 (C2 pedal input) has higher resistance than the other pedal pull-up resistors, giving the capacitor at Pin 15 a longer charging time constant. At power turn on, Pin 15 momentarily remains low (due to the long time constant). The Pedal Latch senses this as a pedal down and latches on the C2 pedal frequencies.

NOTE: Only the Pedal 1- and 2-foot frequency outputs are used.

IC10B OCTAVE SELECT

The 1' pedal bass audio is applied to Pin 9 of IC10B and the 2' pedal bass audio is applied to Pin 5. Normally, the 2' audio is routed through Octave Select IC10B and is used as the Phase-locked Loop reference frequency when Magic Melody and Swing Bass are played from the bass pedals. The 1' audio signal will be selected and applied to the Phase-locked Loop when a bass pedal (C1-E1) is pressed (see 1' Enable).

IC12A, IC12D 1' ENABLE FLIP-FLOP

This set/reset flip-flop is 'set' high at IC12A Pin 3 when Pin 1 of IC12A is applied low when a bass pedal (C1-E1) is pressed. Pin 3 of IC12A switches high, enabling the 1' pedal audio to be applied to the Phase-locked Loop. The high from IC12A Pin 3 is inverted to a low by IC11E disabling the 2' pedal audio. Each time a bass pedal is pressed, a negative going pulse is outputted at Pin 2 of Pedal Latch IC5. This pulse is applied to Pin 13 of IC12D, resetting IC12A Pin 3 low. If a pedal C1-E1 is pressed, the Phase-locked Loop reference is at a 1' pitch. If a pedal F1-C2 is pressed, the Phase-locked Loop reference is a 2' pitch.

CFG/SOLO/AOC SYNC and SCAN CLOCK

The CFG/Pedal Oscillator Frequency (500KHz) is divided in half by IC16B. The Q-bar output (IC16B Pin 12) applies 250KHz to the CFG. The Q output (IC16B Pin 13) is divided-by-two twice by IC22B and IC22A. The 62.5KHz square wave is used to clock the Magic Genie 4' and AOC Decoder (IC6) and the Solo Generator IC19.

IC21B, IC21A SYNC PULSE TRIGGER

The CFG serial data has 72 distinct time points. At time point 72 (end of scan) a sync pulse is outputted from Pin 22 of the CFG and applied to the clock input of the Sync Pulse Trigger IC21B Pin 11. The data input to IC21B is high (+14.5V). When the sync pulse occurs, the high at the data is transferred to the Q output (IC21B Pin 13). The Q output of IC21B is connected to the D input of IC21A (Pin 5). On the next clock pulse outputted by divider IC16B, the Q-bar output (Pin 2 of IC21A) switches low applying a sync pulse to Magic Genie 4' and AOC Decoder IC6. The Q output (Pin 1 of IC21A) switches high which resets the Q output of IC21B low and applies a sync pulse to the Solo Generator Circuit. The next clock pulse applied to IC21A switches the Q output low and the Q-bar output high (because the Q output of IC21B was reset low).

IC12C, IC11C, IC12B SERIAL DATA ENABLERS

When the Magic Genie Chord tabswitch is on, positive voltage is applied to Pin 9 of IC12C. This enables serial data (corresponding to the three or four note Magic Chord) to pass through IC12C and IC11C to IC12B Pin 5. If the rhythm is not auto stopped, Pin 6 of IC12B will be high enabling the serial data to pass through IC12B to Magic Genie 4' and AOC Decoder IC6.

IC6 MAGIC GENIE 4' and AOC DECODER

Serial Data from the Chord Function Generator is shifted into Decoder IC6. When a sync pulse is applied to the strobe input (Pin 37), the serial data is latched in the Decoder and outputted at Pins 11-22. Active outputs switch high (+14.5V). The high level outputs are applied to the AOC Drivers (see Schematic 4) and to the Magic Genie 4' Divider.

IC8, IC11 DIVIDER, MAGIC GENIE 4' DIVIDER

The CFG/Pedal Oscillator frequency is divided by three by IC8A and IC8B. This frequency (approx. 166KHz) is applied to Magic Genie 4' Divider IC11. The Magic Genie 4' Divider is an octave synthesizer which generates an octave of pitches.

When an output (Pins 11-22) of Magic Genie 4' and AOC Decoder IC6 switches positive, a keying diode connected to the active output of IC6 is forward biased. Audio signal is applied through the diode to 4' Genie Chord Preamp IC6C.

IC6C 4' GENIE CHORD PREAMP

When any output of Magic Genie 4' Divider IC11 is biased on, audio signal is applied to IC6C 4' Genie Chord Preamp. IC6C has a gain factor of one and is used as a summing amplifier. The signal outputted by IC6C is applied to the Lower 4' Flute and String Filters.

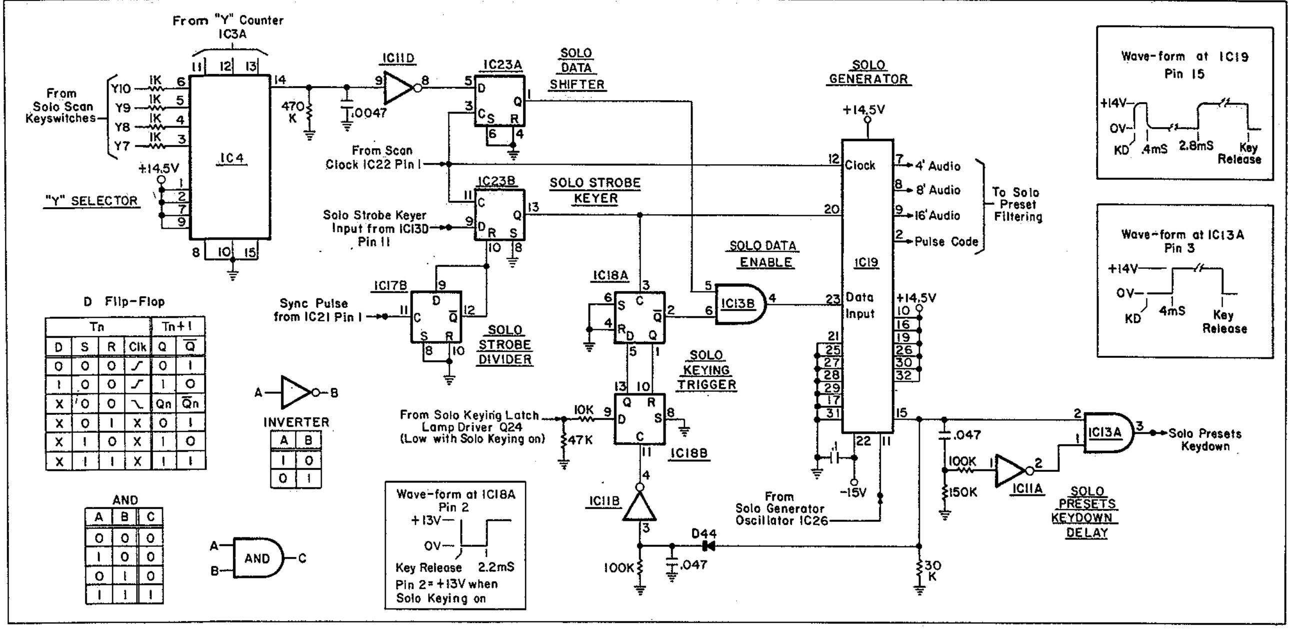
SOLO GENERATOR

The upper keyboard Solo Keyswitches are scanned by the Chord Function Generator X1-X12 outputs. Solo keydown data is applied to the Y Selector where the data is assigned to a time frame Y7-Y10. The serial data is applied to the Solo Generator. The Solo Generator is a priority note generator which accepts only the first data bit corresponding with the highest keyswitch that is pressed. The Solo Generator Oscillator applies 1.26 Megahertz to the Solo Generator. The Solo Generator contains a frequency synthesizer which outputs audio frequencies (4-, 8- and 16') corresponding to the highest keyswitch pressed. The audio frequencies, pulse code and keying voltage are applied to the Solo Presets Keyers and Filters (see Schematic 16).

SOLO DATA

IC3A 'Y' COUNTER

When a positive pulse is applied to Pin 7 of IC3A, the outputs of IC3A (Pins 5, 4, 3) reset low (000). The reset pulse occurs during an active X12 time point. At the end of the X12 time point, the X12 scan line switches high, clocking the counter. The counter advances and Pin 3 of IC3A switches to a high (Scan Clock Time Point 1 - see Fig. 11). When the next X12 time point ends and IC3A is clocked (Scan Clock Time Point 12 - see Fig. 11), Pin 4 goes high and Pin 3 switches low (010). The counter IC3A continues to advance with each positive transition of the X12 scan time point.


From "Y" Counter IC3A
From Solo Scan Keyswitches
Y10
Y9
Y8
Y7
1K
+14.5V
"Y" SELECTOR
IC4
470K
.0047
IC11D
IC23A
SOLO DATA SHIFTER
From Scan Clock IC22 Pin 1
IC23B
SOLO STROBE KEYER
Solo Strobe Keyer Input from IC13D Pin 11
Sync Pulse from IC21 Pin 1
IC17B
SOLO STROBE DIVIDER
IC18A
IC18B
SOLO KEYING TRIGGER
From Solo Keying Latch Lamp Driver Q24 (Low with Solo Keying on)
10K
47K
IC11B
100K
.047
D44
SOLO DATA ENABLE
IC13B
SOLO GENERATOR
+14.5V
IC19
Clock
Data Input
4' Audio
8' Audio
16' Audio
Pulse Code
To Solo Preset Filtering
From Solo Generator Oscillator IC26
-15V
.047
100K
150K
IC11A
SOLO PRESETS KEYDOWN DELAY
30K
IC13A
Solo Presets Keydown
Wave-form at IC19 Pin 15
+14V
0V
KD .4mS 2.8mS Key Release
Wave-form at IC13A Pin 3
+14V
0V
KD 4mS Key Release
Wave-form at IC18A Pin 2
+13V
0V
Key Release 2.2mS
Pin 2 = +13V when Solo Keying on
A
B
C
INVERTER
AND

D Flip-Flop

Tn				Tn+1	
D	S	R	Clk	Q	$\overline{Q}$
0	0	0	╱	0	1
1	0	0	╱	1	0
X	0	0	╲	Qn	$\overline{Qn}$
X	0	1	X	0	1
X	1	0	X	1	0
X	1	1	X	1	1

INVERTER

A	B
1	0
0	1

AND

A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 10 - Solo Generator

IC4 'Y' SELECTOR [See Fig. 10].

A three bit code is applied to Pins 13, 12 and 11 of IC4. The data inputs to IC4 are the Y collector lines of the Solo Scan Keyswitches (Y7-Y10). Each Y collector line is twelve X scan pulses wide. After a Y line is scanned (X1-X12) the three bit code from Counter IC3A changes, connecting the data on the next Y collector through IC4 to the Solo Data Shifter IC23A.

The Y7 line does not become active until the 'Y' counter outputs a binary 2 (010 at Pins 13, 12 and 11 respectively). This delays the start of the Solo keyswitch scan until the Scan Clock, IC22 Pin 1 is at time point 13. (See Circuit Description for explanation of 'Y' Counter IC3A and Fig. 11 for timing of Scan Clock IC22 Pin 1 and first Solo Data Input bit IC23A Pin 5). The inputs to IC4 are normally high and go low when active. The output (Pin 14) of IC4 follows the selected input and goes low when keydown data is present.

IC11D, IC23A INVERTER, SOLO DATA SHIFTER [See Fig. 10].

The negative going pulses outputted by Y Selector IC4 are inverted by IC11D and applied as positive pulses to the data input (Pin 5) of IC23A. (The data applied to IC23A does not align with the scan clock due to delays in the CFG and the length of the wires.) When clocked by the Scan Clock, active data bits (high levels) are shifted to the Q output (Pin 1 of IC23A). This aligns the Solo Data with the Scan Clock. When IC13B is enabled, Solo Data is applied to the Solo Generator IC19.

NOTE: See Fig. 11 for Solo Data Input to IC23A Pin 5, Scan Clock and Solo Keyswitch Data [IC19 Pin 23].

ENABLING SOLO GENERATOR

Several conditions must be met before the Solo Generator will output audio signal. These conditions are as follows (see Fig. 10 and 11).

1) A sync pulse (from the CFG) must be applied to the Solo Strobe Divider IC17B. This divider enables (or resets) the Solo Strobe Keyer IC23B. The sync pulse also resets 'Y' Counter IC3A.
2) Eight time points after the CFG sync pulse, the Solo Sync Decoder applies a positive pulse to the data input (Pin 9) of Solo Strobe Keyer IC23B. If IC23B is enabled (reset input low) the decoder pulse is clocked to the Q output of IC23B.
3) When the Q output (Pin 13) of IC23B applies a positive pulse to IC19 Pin 20, the Solo Generator is reset.
4) Serial data is clocked into the Solo Generator by the Scan Clock. After 72 time points, an internal strobe latches the serial data and the Solo Generator outputs the corresponding audio frequencies and a keying voltage. This data remains latched in the Solo Generator until a reset pulse is applied to Pin 20 of IC19.
5) The Solo Generator Oscillator applies a high frequency to the Solo Generator. The Solo Generator contains an internal frequency synthesizer which outputs the 4-, 8- and 16-foot pitches of the highest keyswitch pressed.

IC9C, IC13D SOLO SYNC DECODER

[See Schematic 15]

When the CFG outputs a sync pulse, Pins 5, 4 and 3 of Y Counter IC3A are reset low. The sync pulse occurs while the X12 time point is active. Immediately after the sync pulse, the X12 time point switches high and Y Counter IC3A outputs a high at Pin 3. The other two outputs of IC3A (Pins 5 and 4) remain low at this time. At time point 8, all three inputs to IC9C will be low, switching its output (Pin 10) high for the duration of the X8 pulse. This pulse is applied to IC13D Pin 13. At this time, Pin 12 of Ic13D is also high and a positive pulse is outputted at Pin 11 and applied to the Solo Strobe Keyer and to the reset inputs of Upper Keyboard Keydown Counter IC3B and Keydown Detector IC17A.

IC23B, IC17B SOLO STROBE KEYER, DIVIDER

[See Fig. 10].

Solo Strobe Keyer IC23B is enabled when the reset input (Pin 10) is low. When enabled, the Solo Sync Pulse (Time Point 8) is clocked to the Solo Generator (this pulse aligns with the ninth scan clock pulse at Pin 13 of IC23B) and enables the Solo Generator. (See Fig. 11.)

Each Sync Pulse applied to Solo Strobe Divider IC17B Pin 11 causes the output (Pin 12) to switch high or low. This causes the Solo Generator to be enabled on every other scan of the CFG because only the first Solo Strobe (Time Point 8) is applied to the Solo Generator (Pin 20). The second Solo Strobe pulse (Time Point 81) is not clocked to the Solo Generator because the reset to IC23B Solo Strobe Keyer is held high. The second scan of Solo Keyswitch Data is not accepted by the Solo Generator.

IC13B, IC18A&B SOLO DATA ENABLE, SOLO KEYING TRIGGER [See Fig. 10]

To enable Solo Data to be applied to the Solo Generator (Pin 23), Pin 6 of Solo Data Enable IC13B must be high. There are two ways of enabling data to reach the Solo Generator, normally and Solo Keying (black pushbutton pressed).

Normal [Solo Keying Button Off]

Assume Pin 6 of IC13B is high. When a solo keyswitch is pressed, solo data is applied to the Solo Generator. Pin 15 of the Solo Generator switches high. This is inverted by IC11B and applies a low to the clock input (Pin 11) of IC18B. When the highest keyswitch is released, the following sequence occurs.

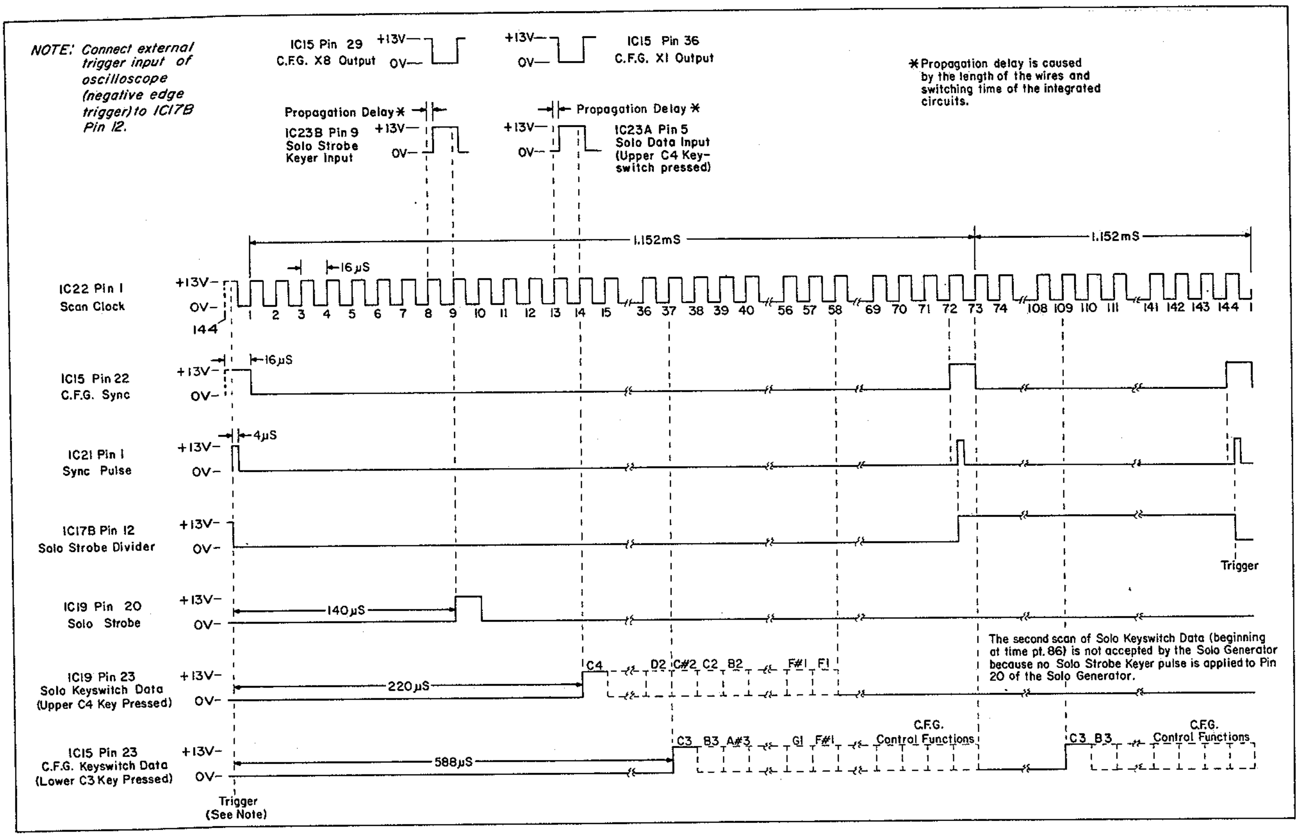
1) Because the Solo Generator 'sees' only the highest keyswitch, releasing the highest keyswitch causes the keying output (Pin 15 of IC19) to switch low (regardless of the number of other keys that are pressed and held below the highest note). This low is inverted to a high by IC11B.
2) The clock input to IC18B switches high transferring the high level at the data input (Pin 9) to the Q output, Pin 13 of IC18B (Data input to IC18A).
3) When the Solo Sync pulse occurs, the high level now present at the data input (Pin 5) of IC18A is transferred to the Q output and the Q-bar output switches low. The solo scan following the solo sync pulse is prevented from being applied to the Solo Generator because Solo Data Enable IC-13B Pin 6 is low.
4) The Q output of IC18A is connected to the reset input of IC18B. When the reset input (Pin 10) switches high, the Q output of IC18B (data input to IC18A) switches low.
5) The next solo sync pulse causes the Q-bar output of IC18A to switch high which enables solo data to be applied to the Solo Generator.

Blanking one scan from the Solo Generator causes the next scan to be 'seen' as a new keydown. If two or more keys had been held when the highest keyswitch was released, the Solo Generator would then 'see' the highest key still pressed as a new keydown and output that frequency.

Solo Keying [See Fig. 10]
[Solo Keying Button On]

When the Solo Keying button is pressed, a low is applied from the Solo Keying Latch to the D input (Pin 9) of IC18B. The Q output cannot be switched high, therefore the data input (Pin 5) to IC18A will always be low. This results in the Q-bar output of IC18A always remaining high. This enables every solo keyboard scan to be applied to the Solo Generator. When the highest keyswitch is released, the Solo Generator does not 'see' a new keydown and will not have an output. When a new key is pressed (above the keyswitches that were held down when the highest keyswitch was released), the Solo Generator 'sees' a new keydown and will output the frequency corresponding to the highest note pressed.

NOTE: If the first or second keyswitches below and adjacent to the highest keyswitch were held down when the highest keyswitch was released, the Solo Generator would output that frequency. For example, if an A#3 [or B3] keyswitch and a C3 keyswitch were pressed together. The Solo Generator will output the C3 pitch. If the C3 keyswitch was released and the A#3 [or B3] keyswitch still held down, the Solo Generator would output the A#3 [or B3] pitch.


NOTE: Connect external trigger input of oscilloscope (negative edge trigger) to IC17B Pin 12.

*Propagation delay is caused by the length of the wires and switching time of the integrated circuits.

The second scan of Solo Keyswitch Data (beginning at time pt. 86) is not accepted by the Solo Generator because no Solo Strobe Keyer pulse is applied to Pin 20 of the Solo Generator.

IC15 Pin 29 C.F.G. X8 Output
IC15 Pin 36 C.F.G. X1 Output
Propagation Delay*
IC23B Pin 9 Solo Strobe Keyer Input
IC23A Pin 5 Solo Data Input (Upper C4 Key-switch pressed)
+13V
0V
1.152mS
16μS
IC22 Pin 1 Scan Clock
IC15 Pin 22 C.F.G. Sync
4μS
IC21 Pin 1 Sync Pulse
IC17B Pin 12 Solo Strobe Divider
Trigger
IC19 Pin 20 Solo Strobe
140μS
IC19 Pin 23 Solo Keyswitch Data (Upper C4 Key Pressed)
220μS
C4 D2 C#2 C2 B2 F#1 F1
IC15 Pin 23 C.F.G. Keyswitch Data (Lower C3 Key Pressed)
588μS
C3 B3 A#3 G1 F#1
C.F.G. Control Functions
Trigger (See Note)
144 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 36 37 38 39 40 56 57 58 69 70 71 72 73 74 108 109 110 111 141 142 143 144 1

Fig. 11 - Solo Generator Timing Diagram

IC13A SOLO PRESETS KEYDOWN DELAY

When a Solo Keyswitch is pressed, Pin 15 of the Solo Generator goes high. This high level is applied to Pin 2 of IC13A and through a capacitor to Pin 1 of Inverter IC11A. The positive going pulse applied to Pin 1 of IC11A causes the output of IC11A to switch low for the duration of the pulse. After the pulse, the output of IC11A (Pin 2) switches high. Both inputs to IC13A are now high and a high level is outputted by IC13A to the Solo Keying Circuits (see Schematic 16).

IC26 SOLO GENERATOR OSCILLATOR

The Solo Generator Oscillator provides a high frequency to the Solo Generator which is divided to provide the audio frequencies outputted by the Solo Generator. Diode D43 rectifies the feedback in the tank circuit into a negative voltage. When the solo tuning control is varied or when the Solo Vibrato is enabled this negative voltage is made more (sharp) or less (flat) negative which varies the oscillator frequency.

UPPER KEYBOARD KEYDOWN DETECTOR

Solo Keyswitch keydown pulses are counted by Upper Keyboard Keydown Counter IC3B. The Upper Keyboard Keydown Counter advances with each new keydown causing a new keydown pulse to be outputted by the Keydown Latch.

IC13C SOLO DATA CHOPPER

When two adjacent keyswitches are pressed, Pin 9 of IC13C 'sees' one long bit. The clock pulses applied to Pin 8 of IC13C will switch high and low for each data bit. This causes each data bit to be chopped in half when it's outputted at Pin 10 of IC3C. (See waveform shown on Schematic 15.)

IC17A UPPER KEYBOARD KEYDOWN DETECTOR

The data input (Pin 5) to IC17A is held high. The first pulse applied to the clock input (Pin 3) of IC17A from the Solo Data Chopper will cause the Q output to switch high. The Q output will be reset low each time a positive pulse is outputted from the Solo Sync Decoder (Time Point 8).

IC3B, IC2 UPPER KEYBOARD KEYDOWN COUNTER, LATCH

When reset by a pulse from the Solo Sync Decoder, all outputs of IC3 are reset low. The counter advances on each data pulse outputted from the Solo Data Chopper. All keydown bits for a single keyboard scan have been counted when the CFG applies a sync pulse to IC2, latching the count into the register. The outputs of Counter IC3B are reset low and count the next scan.

NOTE: The Any Keydown output [Pin 15] of Latch IC2 will remain high as long as at least one key is held down. It will be low only when all upper keys are released.

IC1 SCAN COMPARATOR

The Scan Comparator compares the new scan with the previous scan. The keydown data is continuously updated as each scan is latched into Keydown Latch IC2 for comparison with the new scan. If no keys had been pressed, the counter would output a binary zero. This count (zero) would be latched into IC2. If one key is pressed, the counter outputs a binary one. The binary one is greater than the binary zero causing IC1 Pin 13 to output a high level. When a sync pulse is applied to Pin 9 of IC2, the binary one and the high level outputted by IC1 are latched into IC2. After the next scan, the counter input and the latch input to the comparator will both be equal (binary ones) and IC1 Pin 13 will switch low. The high level remains at the input (Pin 13) of IC2 for several sync pulses due to the slow discharge time of the capacitor at the input.

SCHEMATIC 16

SOLO KEYERS AND FILTERS

When a solo keyswitch is pressed, the Solo Generator applies DC keying voltage and audio signal to the Solo Keyers and a pulse code (corresponding to the keyed note) to the Filters. The audio is keyed as either a pulse or a steady signal depending on the Solo Preset selected. The audio signal is applied to the filter of the selected Solo Preset via an analog switch. The Jazz Flute Solo Preset is enabled by ungrounding the inputs to the 4' and 8' Drivers. The pulse code is applied to the Guitar and Jazz Flute voltage controlled filters. As the keyboard frequency increases, the voltage applied to the filters increases, tuning the filters to the audio frequency. After filtering, the audio signal is amplified by the Solo Mixing Preamp, then applied to the Output Mixer where the signal is distributed to the Main and Chorus 2 and 3 amplifiers.

IC12A SOLO VIBRATO OSCILLATOR

The Solo Vibrato Oscillator provides the vibrato and tremolo drive signal used by the Solo Presets. The oscillator is disabled when the glide switch is pressed or when the Piano or Clavecin preset is on. The frequency of the Solo Vibrato Oscillator IC12A can be varied between 4 and 7 Hz by the Solo Vibrato Speed Control. The output waveform is applied through the Solo Vibrato Depth Control to the Tremolo Filter, Jazz Flute/Guitar Modulator Driver and to the Solo Tuning and Vibrato Amplifier.

IC2A&B, Q1 VIBRATO DELAY TRIGGER, SWITCHER

All Solo Presets, except Piano and Clavecin, use a delayed vibrato effect. At keydown, a positive pulse is developed across a capacitor. The pulse is applied to the input, Pin 1, of Inverter IC2A. Its output switches low which causes a capacitor at Pin 3 of IC2B to quickly discharge. Once the capacitor has discharged below the threshold of IC2B, its output, Pin 4, switches positive causing Q1 to saturate, grounding the input to the Solo Vibrato Oscillator for the duration of the keydown pulse.

IC2C GLIDE/VIBRATO KILLER

Pin 6 of IC2C is normally high keeping Diode D31 reverse biased. This enables the Vibrato Delay Trigger. When the Piano or Clavecin Solo Preset is on, positive voltage is applied to Pin 5 of IC2C. IC2C Pin 6 switches low, grounding (via D31) positive voltage normally applied to Pin 3 of IC2B Vibrato Delay Trigger. This causes the output of IC2B (Pin 4) to switch high, saturating Q1 which grounds the input to the Solo Vibrato oscillator.

IC2E VIBRATO DISABLE AND GLIDE KEYER

All Solo Presets, except Piano and Clavecin, use a glide effect. When the Piano or Clavecin Preset is on, Pin 11 of IC2E is grounded through D32 to Pin 6 of IC2C (low when Piano or Clavecin On) disabling the Solo Glide.

When the Glide Switch (left side of expression pedal) is pressed, positive voltage is applied to Pin 11 of IC2E switching its output, Pin 10, low. This accomplishes two functions:

1) it grounds the Vibrato Delay Trigger through Diode D33, disabling the Vibrato Oscillator (see Vibrato Delay Trigger).
2) it connects a resistor to ground through Diode D34, reducing the tuning control voltage input to Solo Tuning and Vibrato Amplifier IC12B. This detunes the Solo Generator Oscillator.

CIRCUIT DESCRIPTION

IC12B SOLO TUNING AND VIBRATO AMPLIFIER

A negative DC voltage is applied to the inverting (-) input (Pin 6) of IC12B. The output of IC12B (Pin 7) will be a positive voltage (approximately +5.5VDC). This voltage is applied to the Solo Generator Oscillator tank circuit (see Schematic 15). When the output of IC12B becomes more positive, the Solo Generator Oscillator Frequency decreases (flat). If the voltage becomes less positive, the Solo Generator Oscillator frequency increases (sharp). Three inputs to IC12B affect the Solo Generator Oscillator.

1) The Solo Tuning Control establishes the reference voltage applied to the Solo Generator Oscillator. When the control is moved, the reference voltage becomes more negative (flat) or less negative (sharp) which affects the frequency of the Solo Generator Oscillator.
2) The vibrato oscillator modulates the reference voltage applied to the input of IC12B. This causes the Solo Generator Oscillator frequency to vary above and below the frequency to which it is tuned.
3) The Glide Switch (left side of expression pedal) makes the input reference voltage more negative when the glide switch is pressed. This causes the output (Pin 7 of IC12B) to become more positive, detuning the Solo Generator Oscillator.

Q4 GUITAR VIBRATO DEPTH SWITCHER

When the Solo Guitar preset is on, positive voltage is applied to the base of Q4. The transistor saturates connecting a resistor to ground. This reduces the amplitude of the vibrato signal applied to the Solo Tuning and Vibrato Amplifier.

IC12D and IC12C TREMOLO FILTER

The speed and depth of the tremolo effect are controlled by the Solo Vibrato Speed and Depth controls. The output of the Solo Vibrato Oscillator is applied to the Tremolo Filter. Pin 13 of IC12D is referenced to the negative rail (-14.6VDC). When the Solo Vibrato Depth Control is at minimum (ground), the output of IC12D (Pin 14) will be approximately +12.5VDC because the gain factor is less than 1 (gain factor = feedback resistance divided by input resistance). This voltage is applied to the non-inverting (+) input of IC12C. The output Pin 8 of IC12C is connected directly to its inverting (-) input Pin 9, making IC12C a voltage follower. Therefore the output of IC12C, Pin 8, will be +12.5VDC. When the Solo Vibrato Depth is increased, the DC voltage input to IC12D is modulated which in turn modulates the output of IC12C creating a tremolo effect for the Solo Brass presets.

IC3B, Q7 BRASS DRIVER

The output of Inverter IC3B is normally low. This grounds the positive DC voltage outputted by Tremolo Filter IC12C and keeps Brass Driver Q7 turned off. When a Solo Keyswitch is pressed, the output of Inverter IC3B switches high which reverse biases Diode D13. The positive voltage outputted by IC12C can now pass to the base of Q7. A capacitor at the base of Q7 begins to charge which causes Q7 to turn on gradually (approximately 25mS). At key release the capacitor rapidly discharges through D13 to the low level at the output of Inverter IC3B Pin 4. The keyed voltage at the emitter of Q7 is applied through the Brass Driver Enable to the Pulse Generator.

IC4B BRASS DRIVER ENABLE

The Brass Driver Enable is an analog switch that is turned on when a positive voltage is applied to Pin 5. When a Solo Brass preset (Bassoon, Oboe, Trombone, Trumpet or Saxophone) is turned on, IC4B is enabled and brass keying voltage is applied to the Pulse Generator and Pulse Keyer.

IC2D PULSE INVERTER

When a Solo Keyswitch is pressed, a negative going pulse is felt at Pin 9 of IC2D. The output of IC2D (Pin 8) switches high for the duration of the pulse. This pulse is applied to the base of Solo Percussion Driver Q6.

Q6 SOLO PERCUSSION DRIVER

A positive pulse is applied to the base of Solo Percussion Driver Q6 when a Solo Keyswitch is pressed. This pulse turns on Q6 applying a positive pulse to either the Solo Guitar/Clavecin or Piano Keyers. The sustain capacitor at the base of Q6 is charged when the keydown pulse is applied to Q6. If the key is held down, the decay time of this pulse is determined by voltage on the snub line (from Percussion Snub Switchers). Diode D36 is reverse biased (because the key is being held down). After snubbing, the remaining capacitor voltage holds Q6 on for the duration of its discharge time. If the key is released before the decay is completed, the capacitor discharges through Diode D36, a resistor, D40 and an 8.2K resistor to ground. If the Solo Piano or Clavecin preset is on, the glide switch becomes a sustain switch. Pressing the sustain (glide) switch applies positive voltage to the cathode of D40 which reverse biases D40. This blocks the discharge path for the capacitor giving long sustain to the Piano and Clavecin.

IC1A, IC1B, IC1E PERCUSSION SNUB SWITCHERS

Turning on the Solo Guitar, Clavecin or Piano preset applies positive voltage to the input of a Percussion Snub Switcher Inverter. The output switches low providing ground for the voltage divider connected to its output. This develops the snubbing voltage for the sustain capacitor at the base of Solo Percussion Driver Q6.

IC8A DISCHARGE PATH SELECTOR

IC8A is an analog switch that is turned on when positive voltage is applied to Pin 13. Pin 4 of Snub Switcher IC1B is high (unless the Solo Piano preset is on), turning on IC8A. This bypasses the resistor connected across Pins 1 and 2 of IC8A, giving the Solo Guitar and Clavecin presets a shorter sustain. When the Solo Piano preset is on, IC8A is off and the resistor is switched into the circuit giving longer sustain to the Solo Piano voice.

IC2F GUITAR SUSTAIN SWITCHER

When the Solo Guitar preset is on, the output of IC2F (Pin 12) is switched low giving a very short sustain to the Solo Guitar preset.

IC4C GUITAR/CLAVECIN DRIVER ENABLE

Turning on the Guitar or Clavecin Solo preset applies positive voltage to Pin 6 of the analog switch IC4C. IC4C turns on applying percussion keydown pulses to the Pulse Generator and Pulse Keyer.

IC4D GUITAR KEYER OUTPUT ENABLE

Turning on the Guitar Solo preset applies positive voltage to Pin 12 of the analog switch IC4D. IC4D turns on applying percussion keydown pulses to the Guitar/Jazz Flute Keyer Output Modulator.

IC3F, IC14, Q13 INVERTER, PULSE GENERATOR, KEYER

The 16-foot audio signal outputted by the Solo Generator is a square wave. This audio is developed into a spike pulse across a capacitor and inverted by IC3F. The audio pulses are applied to the non-inverting (+) input to IC14 Pulse Generator. When the Brass Driver Enable or Guitar/Clavecin Driver Enable is on, keydown voltage is applied to the inverting (-) input to IC14. At initial keydown, the Brass keying voltage increases relatively slow. This voltage causes the waveform at the output of IC14 (Pin 7) to vary from a wide pulse width of low amplitude to a narrow pulse width of high amplitude. This creates the breathy keydown effect for the brass voices. The Solo Guitar and Clavecin keying voltage is a pulse which reaches maximum at keydown and decays slowly. This voltage causes the waveform at the output of IC14 (Pin 7) to vary from a high amplitude narrow pulse width to a low amplitude narrow pulse width. The output of IC14 then passes through Diode D1 and is applied to Pulse Keyer Q13 (because D1 is forward biased by keying voltage from the Brass or Solo Percussion Driver). The audio signal passes through Q13 and is applied via the active switcher to a filter where the tonality of the selected voice is created.

Q14 DISCHARGE REGULATOR

The pulse code is a rectangular wave with a variable duty cycle. The width of the pulses depends on the octave group being keyed. These pulses are applied to the base of Discharge Regulator Q14 causing it to repeatedly turn on limiting the charge on the .0027uf capacitor at the collector of Q14. This affects the waveshape of the audio pulses applied to the Pulse Generator.

IC1D SNUB SWITCHER

When the Bassoon, Oboe or Sax Solo preset is turned on, positive voltage is applied to Pin 9 of IC1D switching its output (Pin 8) low. When the output of IC1D is low, a 68K resistor is switched in parallel with the 150K resistor at Pin 3 of IC14. This reduces the amplitude of the keying voltage applied to the Pulse Generator.

IC1F SNUB SWITCHER

When the Clavecin Solo preset is turned on, positive voltage is applied to Pin 13 of IC1F switching its output (Pin 12) low. When the output of IC1F is low, a 15K resistor is switched in parallel with the 150K resistor at Pin 3 of IC14. This reduces the amplitude of the keying voltage applied to the Pulse Generator.

Brass Filters, Clavecin Filter

When the Trumpet, Sax, Trombone, Clavecin, Oboe of Bassoon Solo preset is turned on, positive voltage is applied to the switcher associated with the selected Solo Voice. Audio signal from the Pulse Keyer Q13 is applied through the active switcher to the associated filter where the tonal quality of the voice is created. The sax tone is developed by applying audio signal to the Trumpet and Trombone active filters and to the passive Sax filter. The Clavecin filter is passive. The Bassoon tonality is developed by applying audio signal to the Bassoon and Oboe active filters. The output of each filter is applied to the Solo Mixing Preamp.

Solo Clarinet Keyer, Filter

When the Solo Clarinet preset is turned on, Diode D15 becomes reverse biased. This enables keydown voltage to pass through D16 to the base of Clarinet Driver Q5. Clarinet Driver Q5 turns on applying positive voltage to the base of Clarinet Keyer Q11 and the anode Of D37. Solo audio signal is applied to the cathode of D37. The audio signal passes through D37 and Q11 when a Solo Key is pressed. This audio passes to the Clarinet Filter Q20 where the tonal quality is developed. The filtered audio is applied to the Solo Mixing Preamp.

Piano Keyer, Filter

When the Solo Piano preset is turned on, Diode D19 becomes reverse biased. This enables keydown voltage to pass through Diode D27 to the anode of D25 and the base of Piano Keyer Q12. Solo audio signal is applied to the cathode of D25. When a Solo key is pressed, this audio passes through D25 and Q12 to the Piano Filter Q21 where the tonal quality is developed. The filtered audio is applied to the Solo Mixing Preamp.

Guitar Filter

When the Solo Guitar preset is turned on, positive voltage is applied to Pin 5 of analog Switcher IC7B turning it on. This enables audio signal from Pulse Keyer Q13 to be applied to the Guitar Filter. The audio signal applied to the Guitar Filter is a rectangular pulse with approximately a 10% duty cycle. The pulse code from the Solo Generator is inverted by IC1C and applied to the control inputs of the Guitar Filters IC7D and IC7C. The pulse code is a rectangular wave whose duty cycle increases as the keyboard frequency increases (see Chart, Schematic 16). The pulses occur at a rate of approximately 83KHz.

The Guitar Filter consists of analog switchers IC7D and IC7C and several capacitors. Each audio pulse applied to Pin 11 of IC7D is gated through IC7D by the pulse code. This affects the duty cycle of the audio pulse. Each audio pulse induces a ringing oscillation in the filter. The rate at which the tank circuit capacitors charge and discharge is determined by the duty cycle of the pulse code. Therefore, as the keyboard frequency increases the pulse code duty cycle increases and the rate of capacitor charging and discharging increases (because the analog switchers are turned on longer than they are turned off). This effectively tunes the Guitar Filter to the frequency of the audio signal being applied to the filter. Transistors Q24 and Q25 form a low pass filter which removes the pulse code frequency from the audio signal. The Solo Guitar audio is applied to the Guitar/Jazz Flute Audio Modulator.

Jazz Flute Keyers

The Solo Jazz Flute voice is a combination of an 8-foot audio signal with a 4-foot percussion pulse and a noise percussion pulse. Three keyers and three filters are required to develop the Jazz Flute tonality. When the Jazz Flute Solo preset is turned on, the inputs to 8-, 4-foot and Noise Drivers Q8, Q9 and Q10 are ungrounded.

When a Solo keyswitch is pressed, a positive pulse is outputted at Pin 8 of IC3D, 4-foot Percussion and 8-foot Delay Pulse Generator. This positive pulse performs two functions:

1) It is applied to 4-foot Driver Q9 turning this transistor on. This applies a positive pulse to the anode of Diode D9 enabling 4-foot audio from the Solo Generator to pass through Keyer Q16 to the Jazz Flute 4-foot Filter. This results in a short burst of 4-foot audio at keydown.
2) It is applied through D22 to Pin 5 of IC3C disabling the 8-foot Driver for the duration of the keydown pulse.

The input to IC3C 8-foot Enable switches low when a Solo Keyswitch is pressed. At the end of the keydown pulse from IC3D, the output of IC3C switches high. The high level causes 8-foot Driver Q8 to turn on applying positive voltage to the anode of Diode D10. The 8-foot audio from the Solo Generator passes through D10 and Keyer Q15 to the Jazz Flute 8-foot Filter.

A positive pulse is outputted at Pin 10 of Noise Percussion Pulse Generator IC3E when a Solo Keyswitch is pressed. This positive pulse turns on Noise Driver Q10 which applies a positive pulse to the anode of Diode D3. Noise signal is passed through D3 and Keyer Q17 to the Jazz Flute Noise Filter Q30 which voices the noise to simulate the sound of air blowing across the mouthpiece of a Flute.

When a Solo Keyswitch is pressed, positive Solo keying voltage is applied to the bases of 4-foot Flute Driver Q9 and Noise Driver Q10. This biases these transistors on slightly which keeps a low level 4-foot Flute and Noise content mixed with the 8-foot Flute signal. The output of the Solo Vibrato Oscillator is connected to the base of 4-foot Driver Q9 via the Vibrato Depth Control. As the vibrato depth is increased, the 4-foot content of the Jazz Flute voice is amplitude modulated.

Jazz Flute Filters

The pulse code from the Solo Generator is inverted by IC1C and applied to the control inputs of the Jazz Flute 4- and 8-foot Filters IC9D, A and B and IC8D, C and B. The pulse code is a rectangular wave whose duty cycle increases as the keyboard frequency increases (see Chart, Schematic 16). These pulses occur at a rate of approximately 83KHz.

The Jazz Flute 4- and 8-foot Filters are identical in operation. References for the 8-foot Jazz Flute Filter will be used in the following discussion. The 8-foot Jazz Flute Filter consists of analog Switchers (IC8D, IC8C and IC8B) and several capacitors. The audio signal applied to IC8D Pin 11 is a square wave. This audio signal is gated through IC8D by the pulse code which affects the audio signal's duty cycle. This causes the capacitor at Pin 8 of IC8C to charge and discharge at a rate determined by the duty cycle of the pulse code. The waveform applied to Pin 8 of IC8C is a triangular wave. The triangular waveform is shaped into a sine wave at the output of IC8C Pin 9. IC8B shapes the sine wave. Transistors Q26 and Q27 form a low pass filter which removes the pulse code frequency from the audio signal. The Jazz Flute audio signal is combined with ~~noise signal and~~ applied to the Guitar/Jazz Flute Audio Modulator.

Guitar/Jazz Flute Modulation

The Guitar and Jazz Flute audio signal is modulated by the vibrato oscillator giving a tremolo effect to these voices.

IC10, Q19 GUITAR/JAZZ FLUTE KEYER OUTPUT MODULATOR, DRIVER

When the Guitar or Jazz Flute Solo preset is turned on, Keyer Output Enable IC4D or IC4A is turned on applying keying voltage to Pin 3 of IC10. Pin 5 of IC10 is a control input. As the voltage increases, the signal amplitude applied through IC10 increases. Vibrato signal is applied to the base of Modulator Driver Q19. The collector of Q19 is connected to the control input (Pin 5) of IC10 modulating the keying voltage. This modulated voltage is applied through Level Shifter Q18 to the Guitar/Jazz Flute Audio Modulator IC11.

Q2 JAZZ FLUTE VIBRATO DEPTH SWITCHER

Positive voltage is applied to the base of Jazz Flute Vibrato Depth Switcher Q2 when the Jazz Flute Solo preset is on. Switcher Q2 saturates, connecting a resistor to ground which reduces vibrato depth for the Jazz Flute Solo preset.

IC11, Q18 GUITAR/JAZZ FLUTE AUDIO MODULATOR, LEVEL SHIFTER

The voltage at the emitter of Level Shifter Q18 is slightly negative, keeping Q18 biased off. When the Guitar or Jazz Flute solo preset is on and a key is pressed, the voltage at the emitter of Q18 switches positive, causing Q18 to saturate which makes the control voltage inputted to the Audio Modulator IC11 Pin 5 less negative. This enables the audio signal at Pin 3 of IC11 to pass through IC11 to the Solo Mixing Preamp. When the Solo Vibrato Depth is increased, the voltage at Pin 5 will be modulated, giving a tremolo effect (audio amplitude modulation) to the Jazz Flute or Guitar Solo voice.

IC13B SOLO MIXING PREAMP

Audio signal from the Solo Filters is applied to the Solo Mixing Preamp. Here, the audio is amplified then routed to the output mixer via the Solo Volume Control.

SCHEMATIC 17

OUTPUT MIXER

The outputs of all the preamp circuits are applied to the Output Mixer. The audio signals are mixed together then routed to any of four volume regulators. The outputs of the volume regulators are amplified before being applied to the crossover filters.

IC2C FLUTE PREAMP

The upper and lower keyboard flute audio is applied to IC2C. This amplifier has a unity gain factor. The output of IC2C is applied:

1) to the base of Leslie Output Amp Q3. This bypasses the volume regulators and permits the flute voices to be heard at minimum expression.
2) to the Leslie Volume Regulator.
3) to the Reverb Limiter.
4) to the Flute Chorus Switcher.

Q1 FLUTE CHORUS SWITCHER

This FET is pinched off by the negative voltage applied to the gate. When the Flute Chorus or Flute/String Celeste tab is turned on, ground is applied to the gate of Q1, turning on the FET. This enables the flute audio to pass to the Flute/String Chorus Audio Mixer IC2D.

IC2D FLUTE/STRING CHORUS AUDIO MIXER

The upper and lower keyboard Symphonic Strings, Magic Melody Strings, Symphonic Wow and Flutes (when the Flute Chorus or Flute/String Celeste tab is on) are mixed by IC2D then applied to the Flute/String Chorus Modulator (see Schematic 9) and to the Squelch Amp IC5C.

FLUTE AND SYMPHONIC STRING CHORUS SQUELCH

The Squelch Amp, Full Wave Rectifier, Comparator, Buffer and Squelch Switchers ground the outputs of the three chorus phases when there is no audio signal applied through the phase modulator circuits. This is to silence the inherent noise that is generated by the chorus modulator.

IC5C SQUELCH AMP

The Symphonic String, Magic Melody String and Flute Chorus audio is amplified by Squelch Amp IC5C and applied to the Full Wave Rectifier.

IC5B, IC5D FULL WAVE RECTIFIER [See Fig. 12].

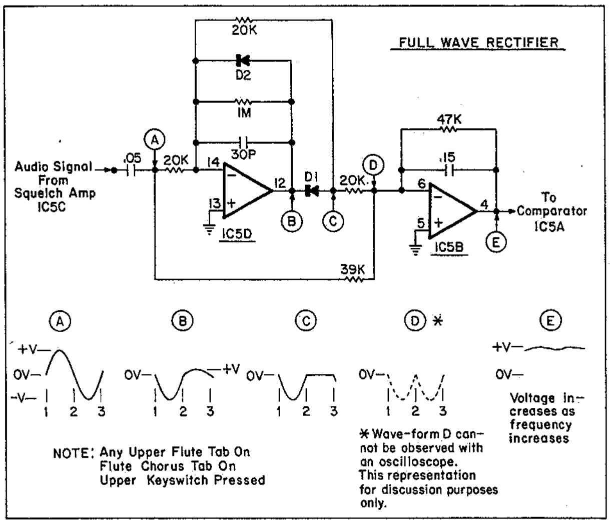
Integrated circuit IC5 is using a split supply (B+ = +14V, B - = -14V). The non-inverting (+) inputs to IC5B and IC5D are grounded referencing the outputs to ground potential when no audio signal is applied to the input (which also 'sees' ground).

When audio signal is applied to the inverting (-) input, Pin 14 of IC5D, the following sequence occurs:

1. During the positive half cycle of the input, Diode D2 is reverse biased. The negative going output (Pin 12) half cycle will have a high gain. (See Fig. 12, Waveforms A & B 1 to 2).
2. As the input waveform passes through zero and goes negative, the output (Pin 12) goes positive.
3. During the negative half cycle, Diode D2 is forward biased. Since a forward biased diode has very low resistance, there is low gain. See Fig. 12, Waveform B, 2 to 3.

The output of IC5D Pin 12 is applied through Diode D1 to Pin 6 of IC5B. Diode D1 becomes reverse biased if the output of IC5D (Pin 12) should become positive. This prevents the waveform from going positive. See Fig. 12, Waveform C.

The input Waveform (A) and the rectified Waveform (C) are summed together and applied to Pin 6 of IC5B. See Fig. 12, Waveform D. IC5B inverts and filters the Waveform into a positive DC voltage. The DC level becomes more positive as the frequency increases. This DC voltage is applied to Comparator IC5A.



NOTE: Any Upper Flute Tab On
Flute Chorus Tab On
Upper Keyswitch Pressed

* Wave-form D cannot be observed with an oscilloscope. This representation for discussion purposes only.

Fig. 12 - Squelch Audio Rectifier

IC5A COMPARATOR

The non-inverting (+) input to Comparator IC5A is a positive DC voltage. Since there are no feedback components used in the comparator, the output (Pin 4) swings to the positive rail (+14 volts). This voltage reverse biases Diode D7. The Full Wave Rectifier IC5D & 5B outputs a positive voltage when audio signal is applied to the rectifier. When this voltage exceeds the reference voltage (Pin 2 of IC5A) the Comparator output swings to the negative rail (-14 volts). Since the anode of Diode D7 is now more positive than the cathode, D7 becomes forward biased.

Q9, Q6-8 BUFFER, SQUELCH SWITCHERS

When there are no keyswitches pressed, Diode D7 is reverse biased. Buffer Q9 has a positive voltage applied to its base keeping this transistor turned on. The voltage at the emitter of Q9 is applied to the Squelch Switchers Q6-8 turning them on. This grounds the outputs of the chorus modulator to silence any inherent noise generated by the chorus modulator.

When audio signal is applied to the Chorus Modulator, it is rectified into a positive DC voltage and applied to the inverting (-) input of Comparator IC5A. This causes the output to swing to the negative rail (-14V). The positive voltage at the base of Q9 is routed through D7to -14 volts at Pin 3 of IC5A. This causes Q9 to cut off which cuts off the Squelch Switchers. When the Squelch Switchers cut off, the chorus modulator output is applied to the Main, Chorus Two and Chorus Three Volume Regulators.

Q10 REED CHORUS SWITCHER

Field Effect Transistor (FET) Q10 is pinched off when the voltage at the gate is more negative than the voltage at the drain and source. When the Main Chorus or Main Celeste tab is turned on, the negative voltage at the gate is grounded. The FET now passes chorus modulated reed signal to the Main Volume Regulator.

REVERB

All audio signal (except 16' Main Flute) is applied through the Reverb circuit to all four Volume Regulators.

IC3, IC2A REVERB LIMITER, DRIVER

The Reverb Limiter IC3 has a control input at Pin 5. Initially, Limiter Driver Q4 is cut off. This 'opens' the control input of IC3 to its maximum amount. Audio signal is applied through IC3 and is amplified by Reverb Driver IC2A. The audio is then applied:

1) through the reverb spring to the Reverb Recovery Amp IC2B where the audio is amplified and
2) to the Reverb Limiter Driver Q4.

This audio is equally distributed to all four volume regulators via the Reverb Length Control.

Q4 REVERB LIMITER DRIVER

The audio signal outputted by the Reverb Driver is rectified into a positive voltage by Diodes D6 and D3. This positive voltage turns on Q4 which reduces the positive voltage applied to the control input of IC3. Therefore, as the amplitude of the signal increases (due to more keys or tabs being pressed), the DC voltage level applied to the control input of the Reverb Limiter is reduced and the signal level applied to the Reverb Spring remains constant.

Q21 VOLUME REGULATOR DRIVER

The amplitude of the signal at the output of the volume regulators is controlled by the Volume Regulator Driver Q21. Pressing the expression shoe down opens the shutter in Expression Pedal Photocell, decreasing the photocell's resistance, which increases the voltage on the base of Q21. This in turn increases the emitter voltage of Q21. Applying this voltage to Pin 5 of the volume regulators increases the amplitude of their output signal.

VOLUME REGULATORS, OUTPUT AMPS

The Flute signal is applied to the Leslie Volume Regulator. The Bass, Reed, Solo, Right Channel Rhythm and Chorus Phase One signal is applied to the Main Channel Volume Regulator. Applied to the Chorus Two and Chorus Three Volume Regulators are signals from the Chorus Modulator, Solo and Left Channel Rhythm. The Reverb and Auxiliary Input are equally distributed to all four Volume Regulators. The outputs of the Volume Regulators are applied to the Output Amps where the signal is applied as a low impedance to the crossover filters.

SCHEMATIC 18

POWER SUPPLY

AC line voltage is converted into positive and negative DC supply voltages using transformer T1 and rectifier bridge D1. The pushbutton lamp voltage is regulated by IC1. The +15 volt supply is regulated by IC2 and the -15 volt supply is regulated by IC3. The positive and negative supply voltages are applied through decoupling resistors located on various boards. Zener diodes provide regulation to some of the circuits. A separate winding on T1 provides 12VAC for the tab panel lamps.

AC line voltage is converted into positive DC supply voltage using transformer T2 and rectifier bridge D2. This voltage is applied to the five power amplifiers. A zener diode regulates the voltage applied to the expression pedal photocell bulb.

A 5-amp slo-blo fuse is employed in the primary circuit of the power supply to prevent component damage which may be caused by a short circuit. Each power amplifier is protected by a 3-amp slo-blo fuse at its DC input. The low voltage DC circuits (developed by T1) are protected by a 1-amp slo-blo fuse.

TR1 LESLIE TREMOLO SWITCH

Turning on the Leslie Tremolo Flute tab applies ground to the Leslie Photocell Lamp, illuminating the lamp. The photocell resistance decreases, activating the Triac TR1, applying AC voltage to the Leslie motor.

SCHEMATIC 19

CROSSOVER FILTERS AND AMPLIFIERS

IC2A, IC2B BASS LOW PASS FILTER

Audio from the Main, Leslie, Chorus Two and Chorus Three Output Amps is summed together through 10K resistors and applied to the Bass Low Pass Filter. This filter removes all but the low frequency signal (filter cutoff is approximately 180Hz) and applies it to the Bass Amplifier.

Q13, Q15, Q17, Q19 FILTERS

Audio from the Main, Leslie, Chorus Two and Chorus Three Output Amps is applied to its respective filter circuit. The filters pass the high frequencies (above 180Hz) to their respective amplifiers.

CIRCUIT DESCRIPTION

AMPLIFIER

The function of the preamp is to boost the signal voltages to a point where they can be used by the driver and pre-driver circuits. The Differential Preamp Q2 senses the signal at the output of the amplifier and controls it by regulating the signal input at the preamp. The pre-driver Q1 inverts the audio voltage and applies it to the Driver Q3. The output transistors convert the audio voltages from the driver into high-current, low-voltage output signal that is connected via Relays RL1 and RL2 to the speakers.

Q12, Q16 RELAY DRIVERS

At power turn on, the 100uf capacitor at the base of Q12 begins to charge. When this capacitor has charged (approximately 8 sec.), Q12 turns on. Positive voltage is applied to Q16 causing Q16 to turn on energizing the speaker relays. The relays will de-energize when a headset is plugged into the headphone jack.

Q14 ORGAN 'OFF' DISCHARGE SWITCHER

The voltage at the base of Q14 is slightly negative, keeping Q14 biased off. At organ turn off, the -25 volt supply collapses instantly (because there is no filter capacitor in the power supply). The base of Q14 switches positive which discharges the 100uf capacitor to ground and de-energizes the speaker relays.

ADJUSTMENTS

All adjustments have been made at the factory. Normally, the only time an adjustment would be required in the field is when a repair has been made to the specific circuit where the adjustment is located.

NOTE: Unless specified, all tabs are off and controls at minimum.

SCHEMATIC 1

Board A

MASTER OSCILLATOR TUNING PROCEDURE

1) Press the upper 16-foot Trombone tab.
2) Hold down an upper keyswitch (C2 for example).
3) Using a tuning fork or electronic tuning device corresponding to the key being held (in this case C2) adjust the coil using a non-metalic tuning wand for a zero beat between the organ tone and the tuning device.
4) When this note is properly tuned, the TOS tuning is locked in.
5) Press the Genie String Bass tab and the Bass Full tab.
6) Hold down the upper C2 and the lower C3 keyswitches. No roll or beat should be heard. If a roll or beat is heard, perform the CFG/Pedal oscillator Tuning Procedure.
7) Release the lower C3 keyswitch.
8) Turn Solo Bassoon preset on.
9) Set Solo Tuning and Solo Volume controls to mid-point.
10) Hold down the upper C2 keyswitch. No roll or beat should be heard. If a roll or beat is heard, perform the Solo Generator Oscillator Tuning Procedure.

SCHEMATIC 2

Board J

VIBRATO SPEED ADJUSTMENT

1) Connect oscilloscope to Pin 1 of IC1A Vibrato Oscillator.
2) Turn Vibrato Speed Adjust VR1 until one cycle takes approximately 160mS to complete.
3) This correctly adjusts the vibrato speed for 6.3Hz.

VIBRATO DEPTH ADJUSTMENT

1) Check vibrato speed adjustment.
2) Connect oscilloscope to wiper of Vibrato Depth Adjust VR2.
3) Turn Vibrato Tab on.
4) Adjust VR2 for 3.2V peak to peak.

SYMPHONIC WOW LEVEL SET

1) Connect negative (ground) voltmeter lead to -15 volt supply.
2) Connect positive lead to collector of Q13.
3) Voltmeter should read between 2.7 volts and 3.7 volts DC.
4) If adjustment is required, substitute the resistor at the base of Q13 with a decade box, resistor substitution box or a potentiometer. The initial value should be approximately 330K ohms.
5) Adjust for 3.2 volts DC.
6) Install fixed component and check voltage at the collector of Q13.

ADJUSTMENTS

SCHEMATIC 4

Board D

AOC RANGE ADJUSTMENT

1) Turn all upper and lower keyboard tabs off.
2) Turn on upper keyboard 8-foot Flute tab.
3) Hold down the lower keyboard C1 keyswitch.
4) Play a chromatic scale on the upper keyboard C2 to C3 keyswitches.
5) AOC note should be heard on nine notes D#2 through B3.
6) If more (or less) than nine notes are heard, adjust AOC Range Adjustment VR1 for a nine note range.

SCHEMATIC 7

Board M

REED CHORUS SPEED ADJUSTMENT

1) Connect oscilloscope to Pin 1 of IC2A Chorus Oscillator.
2) Turn Chorus Speed Adjust VR1 until one cycle takes approximately 170mS to complete.
3) This correctly adjusts the Chorus Oscillator for 6Hz.

NOTE: When the Main Celeste tab is on, chorus speed decreases to between 700mS and 900mS.

REED CHORUS BIAS ADJUSTMENT

To adjust the DC offset voltage:

1) Turn Main Celeste tab on.
2) Turn Upper Trombone tab on.
3) Hold down an upper keyboard key and turn the potentiometer in both directions until distortion occurs. Proper setting is the midpoint between the distortion regions.

SCHEMATIC 8

Board H

PERCUSSION THUMP ADJUSTMENT

The purpose of this adjustment is to minimize the DC transient (thump) which may occur when playing any of the repeat percussion voices (Harmonic 4', 2-2/3', Mandolin and Banjo). To adjust:

1) Place expression pedal at maximum expression.
2) Turn rhythm speed control to minimum.
3) Turn Repeat tab on.
4) Turn Banjo preset on.
5) Adjust VR2 for minimum thump.

NOTE: If thump cannot be reduced satisfactorily by adjustment, then replace Modulator IC3.

GENIE THUMP ADJUSTMENT

The purpose of this adjustment is to minimize the DC transient (thump) which may occur when the lower keyboard Piano, Banjo or Guitar tabs are on and a rhythm is playing. To adjust:

1) Place expression pedal at maximum expression.
2) Turn rhythm volume controls to minimum.
3) Place rhythm balance control to Brush (extreme right of control movement).
4) Select Metronome Rhythm.
5) Adjust VR1 for minimum thump.

NOTE: If thump cannot be reduced satisfactorily by adjustment, then replace Modulator IC5.

SCHEMATIC 15

Board R

CFG/PEDAL OSCILLATOR TUNING PROCEDURE

1) Check tuning of Master Oscillator. (See Master Oscillator Tuning Procedure.)
2) Press the upper 16-foot Trombone tab.
3) Press the lower Genie String Bass tab and Bass Full tab.
4) Hold down the upper keyboard C2 keyswitch and the lower keyboard C3 keyswitch.
5) Tune the CFG/Pedal Oscillator tuning coil (L1) for a zero beat with the upper keyboard tone using a non-metalic tuning wand.
6) When this note is properly tuned, the CFG and Bass Pedal tuning is locked in.
7) Release the lower C3 keyswitch.
8) Turn Solo Bassoon preset on.
9) Set the Solo Tuning and Solo Volume Controls to midpoint.
10) Hold down the upper C2 keyswitch. No roll or beat should be heard. If roll or beat is heard, perform the Solo Generator Oscillator Tuning Procedure.

SOLO GENERATOR OSCILLATOR TUNING PROCEDURE

1) Check tuning of Master Oscillator and CFG/Pedal Oscillator. (See Master Oscillator tuning procedure.)
2) Press the upper 16-foot Trombone tab.
3) Turn Solo Bassoon preset on.
4) Set Solo Tuning and Solo Volume Controls to midpoint.
5) Hold down the upper C2 keyswitch.
6) Tune the Solo Generator Oscillator tuning coil for a zero beat with the upper keyboard tone using a non-metalic tuning wand.
7) When this note is properly tuned, the Solo Generator Oscillator tuning is locked in.

MAGIC CHORD LEVEL ADJUSTMENT

1) Press lower 8-foot Flute tab.
2) Hold down the lower keyboard G1, C2 and E2 keyswitches.
3) Release the keys.
4) Place Magic Chord tab on.
5) Press C1 keyswitch (C chord).
6) Adjust Chord Level potentiometer for equal volume between the Flutes in both the chord and non-chord modes. (Repeat Steps 2 through 6 as required.)

SCHEMATIC 17

Board V

MAXIMUM VOLUME ADJUSTMENT

1) Press upper Trombone and Clarinet tabs.
2) Place Expression Pedal at maximum (Full volume).
3) Press the upper C1, E1, G2, A#2 and C2 keyswitches simultaneously (C7 chord).
4) Adjust Maximum Volume potentiometer for maximum volume without audible distortion.

MINIMUM VOLUME ADJUSTMENT

1) Press lower Piano tab and lower Full tab.
2) Place expression pedal at minimum (softest volume).
3) Press lower C2 keyswitch.
4) Adjust Minimum Volume potentiometer until the audio signal is barely audible.

SCHEMATIC 19

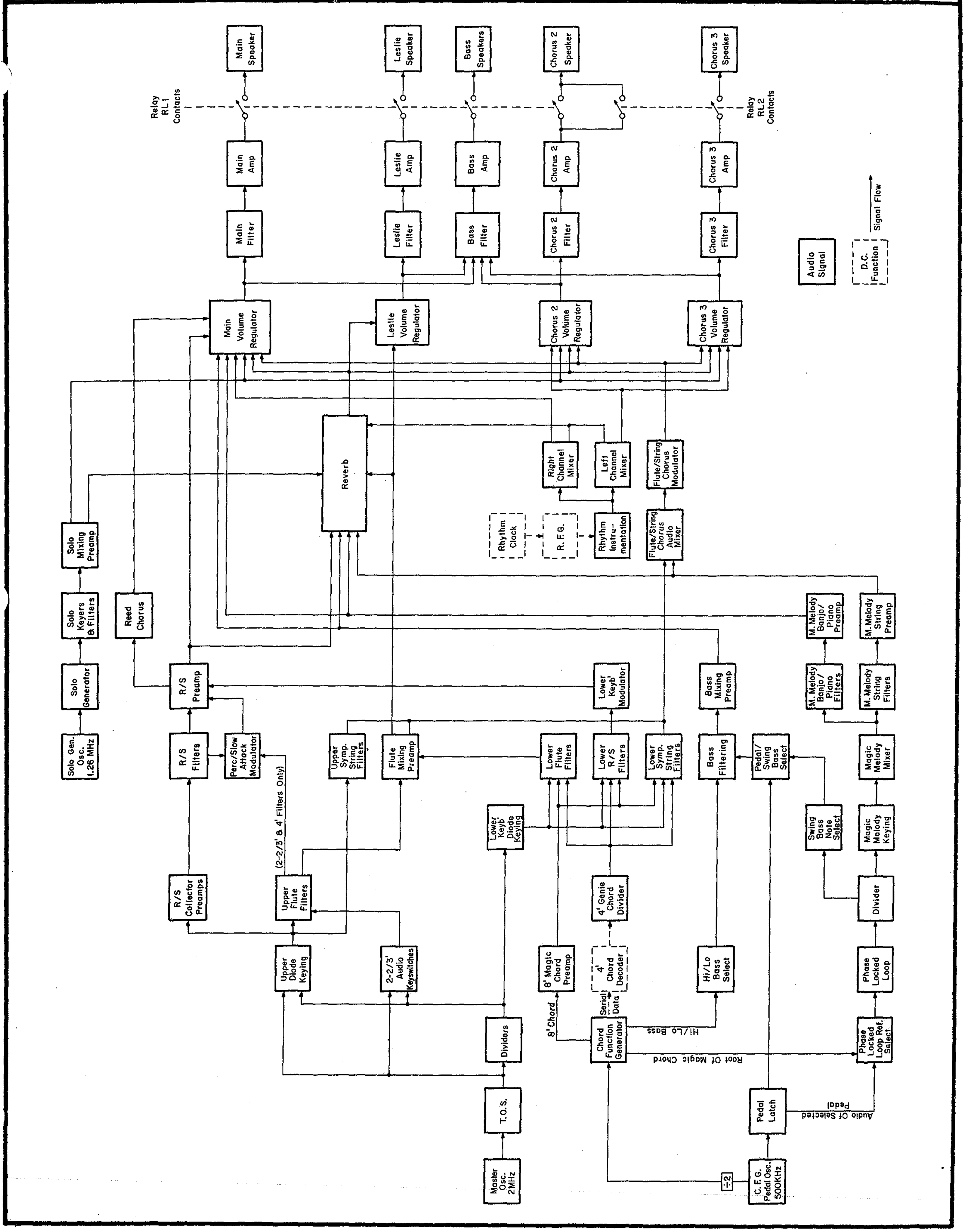
Board T

AMPLIFIER BIAS ADJUSTMENT

[To be performed after replacement of amplifier components]

1) Unplug organ, remove back and expose the component side of the Power Supply/Amplifier chassis.
2) Remove the 3-amp fuse located on the Amplifier Board.
3) Connect a milliammeter to the fuse posts (positive lead to +55 volts, negative lead to collector of Q5).
5) Turn on power and allow Power Supply to stabilize.
6) Current should read between 20 and 30 mA.
7) If adjustment is necessary, turn off power and remove the factory-tailored resistor.
8) Connect a variable resistor (decade box, potentiometer, resistor substitution box, etc.) to the wire wrap pins. The initial value should be approximately 10K ohms.
9) Turn on power and allow power supply to stabilize.
10) Adjust variable resistor for a curent reading of 25mA.
11) Turn off power and solder proper resistor to wire wrap pins.
12) Turn on power and check current.
13) Turn off power, remove milliammeter leads, insert fuse.

AUDIO SIGNAL FLOW BLOCK DIAGRAM


Main Speaker
Leslie Speaker
Bass Speakers
Chorus 2 Speaker
Chorus 3 Speaker
Relay RL1 Contacts
Relay RL2 Contacts
Main Amp
Leslie Amp
Bass Amp
Chorus 2 Amp
Chorus 3 Amp
Main Filter
Leslie Filter
Bass Filter
Chorus 2 Filter
Chorus 3 Filter
Audio Signal
D.C. Function
Signal Flow
Main Volume Regulator
Leslie Volume Regulator
Chorus 2 Volume Regulator
Chorus 3 Volume Regulator
Reverb
Right Channel Mixer
Left Channel Mixer
Flute/String Chorus Modulator
Rhythm Clock
R. F. G.
Rhythm Instru-mentation
Flute/String Chorus Audio Mixer
Solo Mixing Preamp
Solo Keyers & Filters
Solo Generator
Solo Gen. Osc. 1.26 MHz
Reed Chorus
R/S Preamp
R/S Filters
Perc/Slow Attack Modulator
Lower Keyb' Modulator
Bass Mixing Preamp
M. Melody Banjo/Piano Preamp
M.Melody String Preamp
M. Melody Banjo/Piano Filters
M. Melody String Filters
Upper Symp. String Filters
Flute Mixing Preamp
Lower Flute Filters
Lower R/S Filters
Lower Symp. String Filters
Bass Filtering
Pedal/Swing Bass Select
Magic Melody Mixer
(2-2/3' & 4' Filters Only)
Lower Keyb' Diode Keying
Swing Bass Note Select
Magic Melody Keying
R/S Collector Preamps
Upper Flute Filters
4' Genie Chord Divider
Divider
Upper Diode Keying
2-2/3' Audio Keyswitches
8' Magic Chord Preamp
4' Chord Decoder
Hi/Lo Bass Select
Phase Locked Loop
8' Chord
Serial Data
Dividers
Chord Function Generator
Hi/Lo Bass
Phase Locked Loop Ref. Select
Root Of Magic Chord
T.O.S.
Pedal Latch
Audio Of Selected Pedal
Master Osc. 2MHz
÷2
C.F.G. Pedal Osc. 500KHz

OSCILLOSCOPE USAGE

An oscilloscope provides a visual image of events which occur too rapidly to be measured with a voltmeter. When properly used, the oscilloscope becomes a valuable aid in troubleshooting electronic organs.

INPUT COUPLING

The input coupling on most oscilloscopes can be switched between direct (DC) or decoupled (AC).

Direct Coupling [DC]

1. The probe is connected directly to the input of the oscilloscope.
2. Once a zero reference is established, positive and negative voltage measurements can be made.
3. Unless otherwise specified, all waveforms shown on the schematics are made using direct coupling.

Decoupled [AC]

1. A capacitor is placed in series with the probe to block any DC voltage which may be present in the AC signal.
2. The image on the oscilloscope will deflect above and below the established zero reference.

CALIBRATION

Any oscilloscope may be calibrated as follows:

1. Set vertical deflection to 5 volts/division (or similar range).
2. Ground the input to the oscilloscope.
3. Align the trace with a horizontal graticule (see Fig. 6A).
4. Unground the input to the oscilloscope, trace should not move.
5. Connect oscilloscope input to a known DC voltage source (i.e. +15 volts).
6. Trace should deflect three divisions in a vertical direction [3 division x 5 volts = 15 volts]. (See Fig. 6B.)
7. Adjust calibration control to obtain a three division (15 volt) deflection.
8. Oscilloscope is now calibrated.

NOTE: If a ten-to-one (or other) attenuator probe is used, the vertical deflection should be multiplied by ten (or other). For example: With a ten-to-one probe, the vertical deflection would have to be set to .5 volts per division to obtain a three division deflection when measuring a 15 volt source.

.5V x 3 Div. = 1.5V   1.5V x 10 atten. = 15V

Input - DC
Vertical - 5 Volts per Division
Trigger - Auto

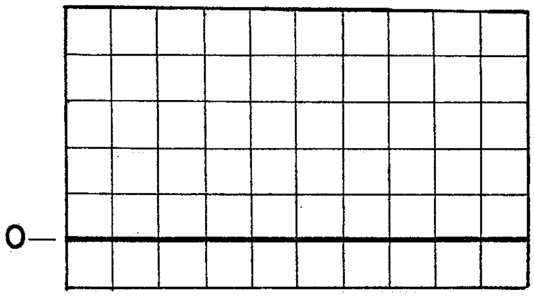


Fig. 6A - Establish Zero Reference

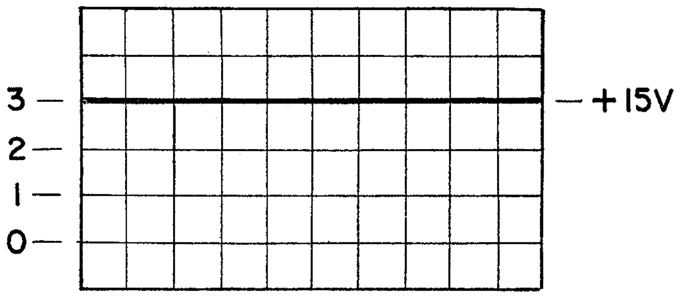


Fig. 6B - Three Division Deflection

TIME BASE

Most oscilloscopes have a horizontal time base which controls the movement (sweep) of the trace across the screen from a few seconds to several microseconds.

Frequency and time are inverse functions. As frequency increases, time decreases. The mathematical formula for determining the frequency of a waveform is $F = \frac{1}{t}$ where frequency (F) is in cycles and time (t) is in seconds.

To determine the frequency of a waveform:

1) Determine the time it takes for the waveform to complete one cycle.
2) In Figure 7, a cycle of the waveform takes five divisions. The sweep is set for 200 microseconds per division. The time required for a single cycle is 200uS x 5 divisions or 1000 microseconds = 1 millisecond = .001 second.
3) Using the formula $F = \frac{1}{t}$, the frequency of the waveform is:

$$F = \frac{1}{.001}$$

$$F = 1000\text{Hz}$$

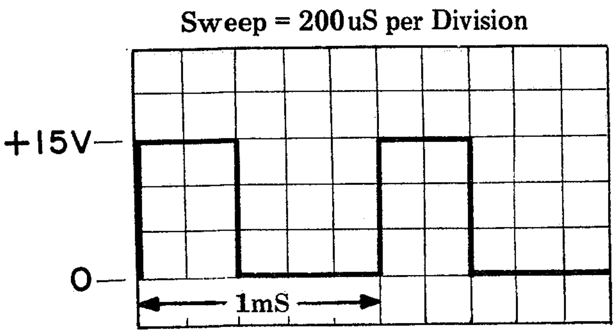


Fig. 7 - Determining Frequency

When observing a waveform, at least two cycles (repetitions) should be observed. This ensures that all of the event (i.e. serial data) is observed. Figure 8A shows a waveform observed with a 20 millisecond per division sweep. When the sweep is decreased to 100 milliseconds per division, two complete serial data cycles can be seen (see Fig. 8B). The sweep may now be increased to display the best image of the event.

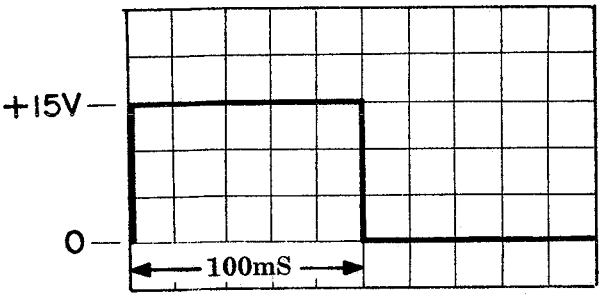


Fig. 8A - Serial data observed with 20mS per Division sweep

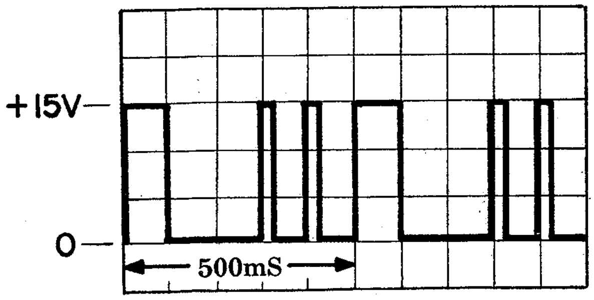


Fig. 8B - Serial data observed with 100mS per Division sweep

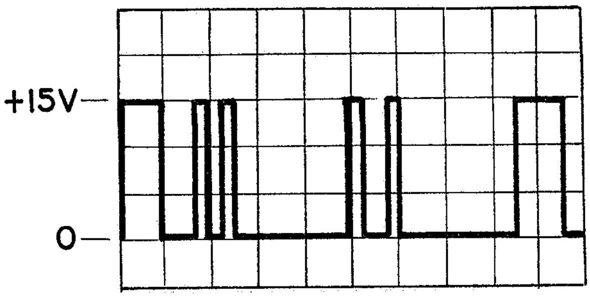


Fig. 9A - Internally Triggered Data

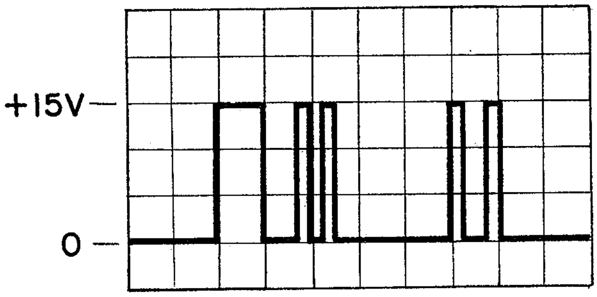


Fig. 9B - Externally Triggered Data

TRIGGERING

Some oscilloscopes have triggered sweep. There are two common types of triggered sweep. Internal triggering relies on the positive or negative going edge of the waveform to start the sweep. The trigger level is controlled by a potentiometer which will cause the sweep to start at the selected voltage level. External triggering is most useful for observing events which occur in a specific relationship to time. Serial data from the Chord Function Generator or Flute Encoder would be an example. Figure 9A shows data being triggered internally. As data bits are added or subtracted from the serial data stream, the image on the oscilloscope will shift dependent on the first data bit (farthest left) used for triggering. The pattern in Figure 9B is externally triggered using the positive edge of the T1 time frame. As data bits are added or subtracted, they will always appear in the same position with respect to the triggering source.

IMPORTANT INFORMATION

SCHEMATIC DRAWINGS, PRINTED WIRING BOARDS

1) The numbering on each printed wiring board begins with Q1, IC1 and D1.
2) Board locations are clearly shown in large letters.
3) Two or more components with the same reference number may be drawn on the same schematic.
4) When components from two or more printed wiring boards are drawn on the same schematic, shaded areas will separate the components and their location will be clearly identified.

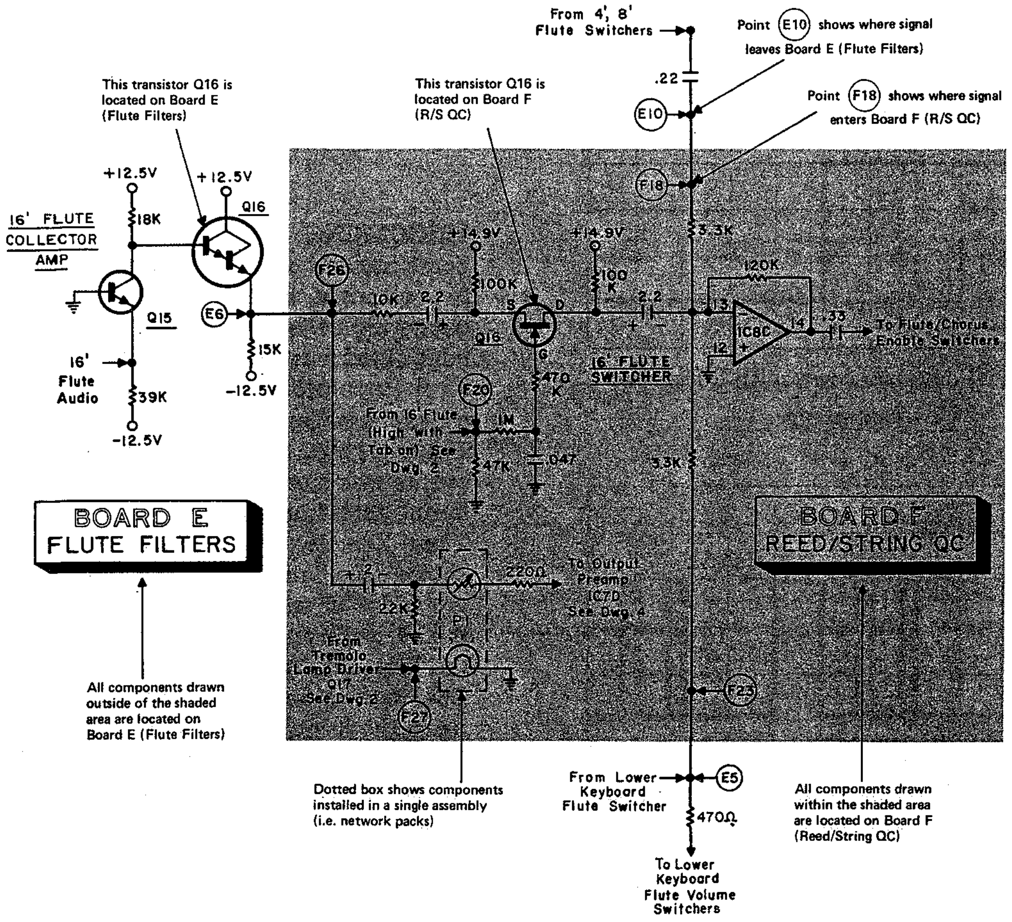
TEST EQUIPMENT

1) All voltages are measured with a Simpson 260 VOM to ground reference.
2) Oscilloscope waveforms are approximations.
3) Unless specified, measurements are made with keyswitches, tabswitches and pushbutton switches in the "off" position and controls at minimum.

NOTE: Actual voltages and waveshapes will vary depending on the accuracy of your test equipment, loading, component tolerances, power supply voltages and other variables.

COMPONENTS

1) Resistors have 5 or 10% tolerances and are rated at 1/4 or 1/2 watt unless otherwise specified.
2) Capacitor values are in microfarads (uf) unless otherwise specified.
3) All components are located on indicated boards unless specified.
4) See Parts List for component part numbers.
5) ✠ Denotes factory-tailored component.
6) Resistors with "R" numbers and capacitors with "C" numbers are located in networks or listed in charts as indicated on individual drawings.


From 4', 8'
Flute Switchers
.22
E10
F18
+12.5V
18K
+12.5V
Q16
16' FLUTE
COLLECTOR
AMP
Q15
E6
16'
Flute
Audio
39K
-12.5V
15K
-12.5V
+14.9V
+14.9V
3.3K
F26
10K
2.2
100K
S
D
100
K
2.2
120K
13
IC8C
14
.33
To Flute/Chorus
Enable Switchers
Q16
G
16' FLUTE
SWITCHER
12
F20
470
K
From 16' Flute
(High with
Tab on) See
Dwg. 2
1M
47K
.047
3.3K
BOARD E
FLUTE FILTERS
BOARD F
REED/STRING QC
2
220Ω
To Output
Preamp
IC7D
See Dwg. 4
22K
P1
From
Tremolo
Lamp Driver
Q17
See Dwg. 2
F27
F23
From Lower
Keyboard
Flute Switcher
E5
470Ω
To Lower
Keyboard
Flute Volume
Switchers

This transistor Q16 is located on Board E (Flute Filters)

This transistor Q16 is located on Board F (R/S QC)

Point (E10) shows where signal leaves Board E (Flute Filters)

Point (F18) shows where signal enters Board F (R/S QC)

All components drawn outside of the shaded area are located on Board E (Flute Filters)

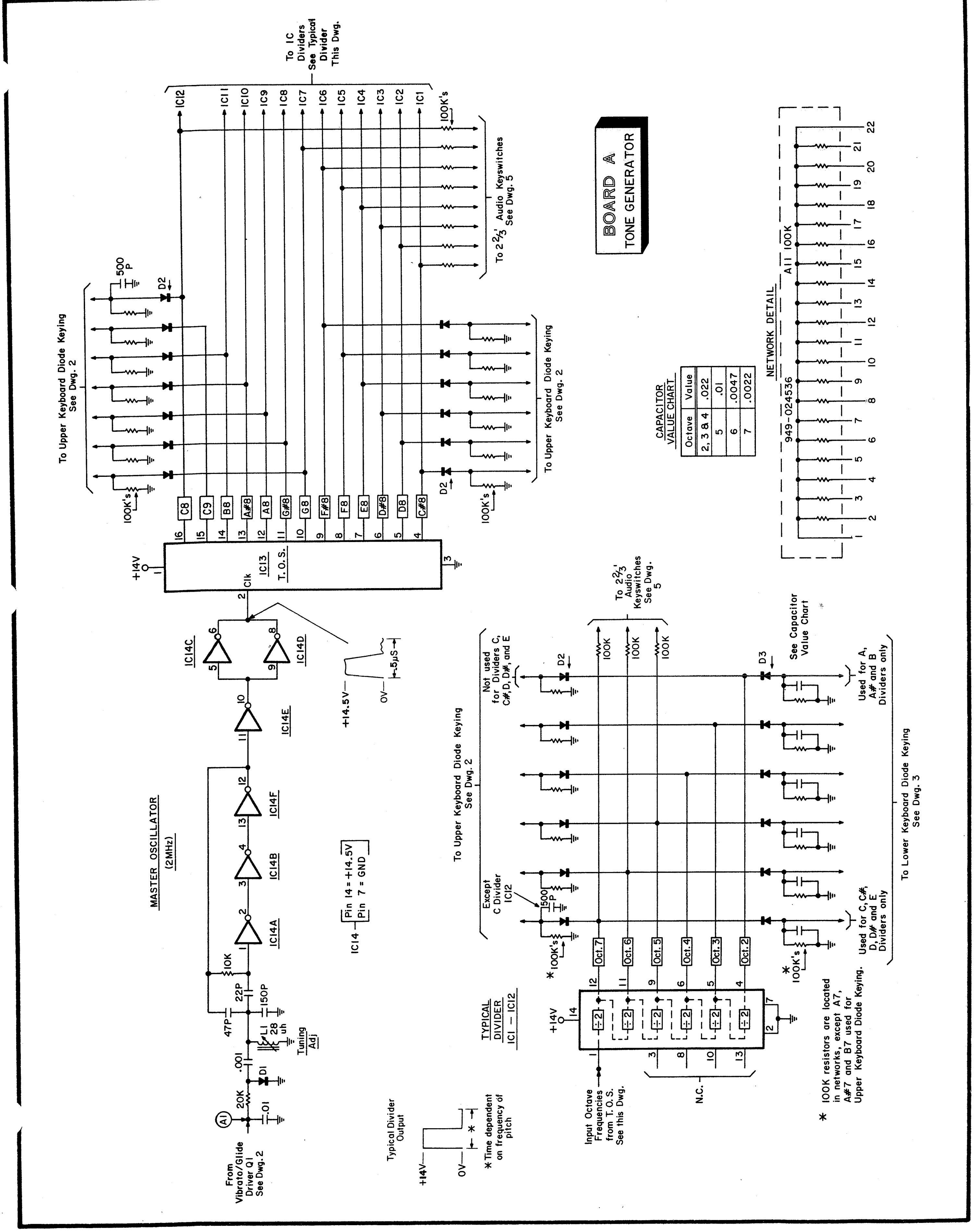
Dotted box shows components installed in a single assembly (i.e. network packs)

All components drawn within the shaded area are located on Board F (Reed/String QC)

Example

TONE GENERATOR

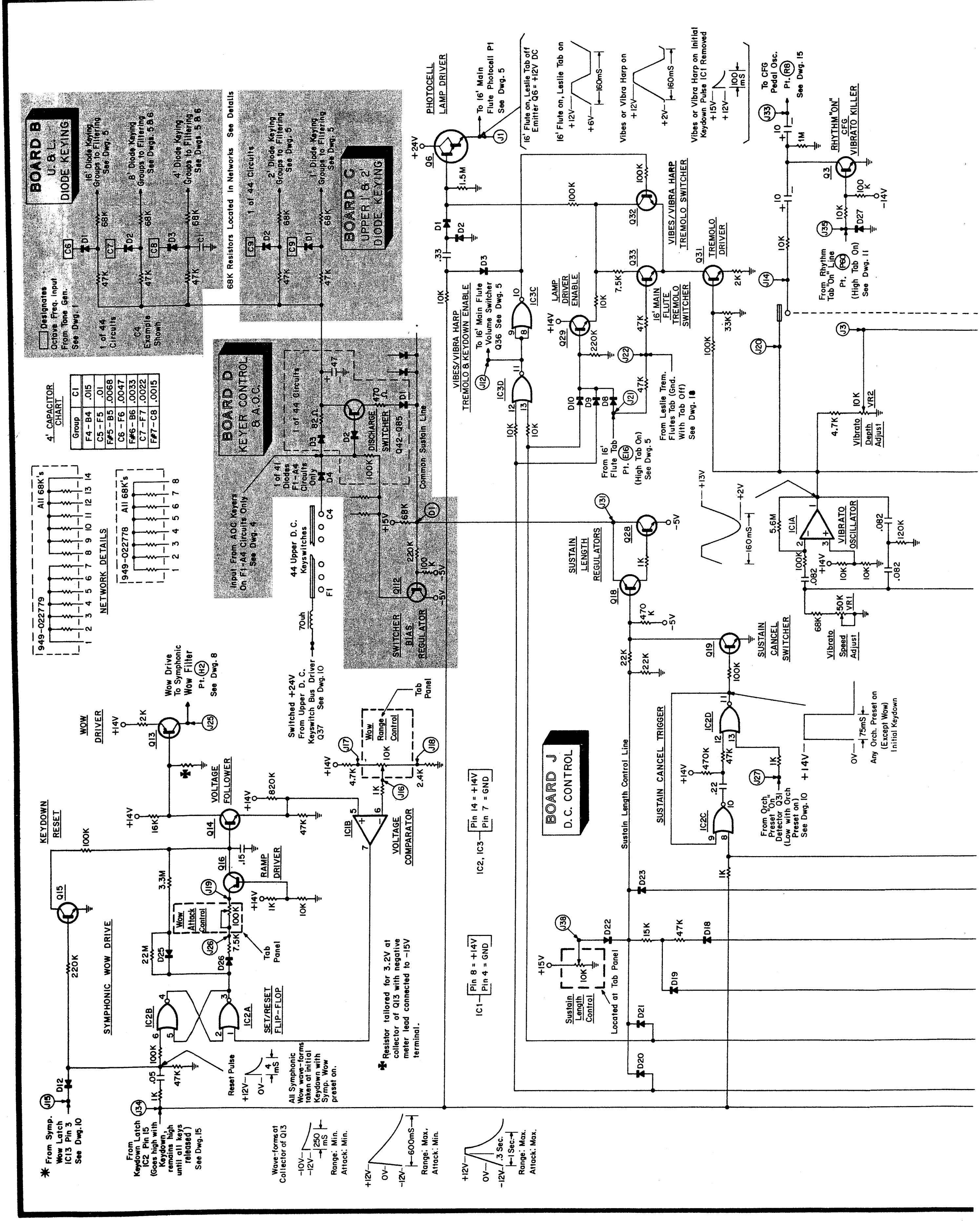
1


BOARD A
TONE GENERATOR
To IC Dividers See Typical Divider This Dwg.
IC12
IC11
IC10
IC9
IC8
IC7
IC6
IC5
IC4
IC3
IC2
IC1
100K's
To 2⅔' Audio Keyswitches See Dwg. 5
To Upper Keyboard Diode Keying See Dwg. 2
500 P
D2
100K's
C8
C9
B8
A#8
A8
G#8
G8
F#8
F8
E8
D#8
D8
C#8
+14V
IC13
T.O.S.
Clk
MASTER OSCILLATOR
(2MHz)
IC14C
IC14D
IC14E
IC14F
IC14B
IC14A
+14.5V
0V
.5µS
IC14 Pin 14 = +14.5V
Pin 7 = GND
10K
22P
150P
47P
L1 28 uh
Tuning Adj
.001
D1
20K
.01
A1
From Vibrato/Glide Driver Q1 See Dwg. 2
Typical Divider Output
+14V
0V
* Time dependent on frequency of pitch
CAPACITOR VALUE CHART
NETWORK DETAIL
949-024536
All 100K
TYPICAL DIVIDER
IC1 — IC12
Not used for Dividers C, C#, D, D#, and E
Except C Divider IC12
D3
See Capacitor Value Chart
Used for A, A# and B Dividers only
Used for C, C#, D, D# and E Dividers only
To Lower Keyboard Diode Keying See Dwg. 3
100K
Oct.7
Oct.6
Oct.5
Oct.4
Oct.3
Oct.2
÷2
N.C.
Input Octave Frequencies from T.O.S. See this Dwg.
* 100K resistors are located in networks, except A7, A#7 and B7 used for Upper Keyboard Diode Keying.

Octave	Value
2, 3 & 4	.022
5	.01
6	.0047
7	.0022

2

UPPER DIODE KEYING & DC CONTROL


BOARD B U. & L. DIODE KEYING
16' Diode Keying Groups to Filtering See Dwg. 5
8' Diode Keying Groups to Filtering See Dwgs. 5 & 6
4' Diode Keying Groups to Filtering See Dwgs. 5 & 6
68K Resistors Located in Networks See Details
Designates Octave Freq. Input From Tone Gen. See Dwg. 1
1 of 44 Circuits
C4 Example Shown
BOARD C UPPER 1 & 2 DIODE KEYING
1 of 44 Circuits
2' Diode Keying Groups to Filtering See Dwg. 5
1' Diode Keying Groups to Filtering See Dwg. 5
BOARD D KEYER CONTROL & A.O.C.
Input From AOC Keyers On F1-A4 Circuits Only See Dwg. 4
1 of 44 Circuits
1 of 41 Diodes F1-A4 Circuits Only
DISCHARGE SWITCHER Q42-Q85
Common Sustain Line
44 Upper D.C. Keyswitches
SWITCHER BIAS REGULATOR
Switched +24V From Upper D. C. Keyswitch Bus Driver Q37 See Dwg.10
NETWORK DETAILS
949-022779 All 68K's
949-022778 All 68K's
PHOTOCELL LAMP DRIVER
To 16' Main Flute Photocell P1 See Dwg. 5
16' Flute on, Leslie Tab off Emitter Q6 = +12V DC
16' Flute on, Leslie Tab on
Vibes or Vibra Harp on
Vibes or Vibra Harp on Initial Keydown Pulse IC1 Removed
To CFG Pedal Osc. Pt. R8 See Dwg. 15
RHYTHM "ON" CFG VIBRATO KILLER
VIBES/VIBRA HARP TREMOLO SWITCHER
TREMOLO DRIVER
16' MAIN FLUTE TREMOLO SWITCHER
LAMP DRIVER ENABLE
VIBES/VIBRA HARP TREMOLO & KEYDOWN ENABLE
To 16' Main Flute Volume Switcher Q36 See Dwg. 5
From Leslie Trem. Flutes Tab (Gnd. With Tab Off) See Dwg. 18
From 16' Flute Tab Pt. E16 (High Tab On) See Dwg. 5
From Rhythm Tab "On" Line Pt. P60 (High Tab On) See Dwg. 11
Vibrato Depth Adjust
VIBRATO OSCILLATOR
Vibrato Speed Adjust
SUSTAIN LENGTH REGULATORS
SUSTAIN CANCEL SWITCHER
SUSTAIN CANCEL TRIGGER
BOARD J D. C. CONTROL
Sustain Length Control Line
Any Orch. Preset on (Except Wow) Initial Keydown
From Orch. Preset "On" Detector Q31 (Low with Orch Preset on) See Dwg. 10
Sustain Length Control
Located at Tab Panel
WOW DRIVER
Wow Drive To Symphonic Wow Filter Pt. H2 See Dwg. 8
VOLTAGE FOLLOWER
VOLTAGE COMPARATOR
Wow Range Control
Tab Panel
KEYDOWN RESET
RAMP DRIVER
Wow Attack Control
SYMPHONIC WOW DRIVE
SET/RESET FLIP-FLOP
Reset Pulse
IC1 Pin 8 = +14V Pin 4 = GND
IC2, IC3 Pin 14 = +14V Pin 7 = GND
From Symp. Wow Latch IC13 Pin 3 See Dwg.10
From Keydown Latch IC2 Pin 15 (Goes high with Keydown, remains high until all keys released) See Dwg.15
All Symphonic Wow wave-forms taken at Initial Keydown with Symp. Wow preset on.
Wave-forms at Collector of Q13
Range: Min. Attack: Min.
Range: Max. Attack: Min.
Range: Max. Attack: Max.

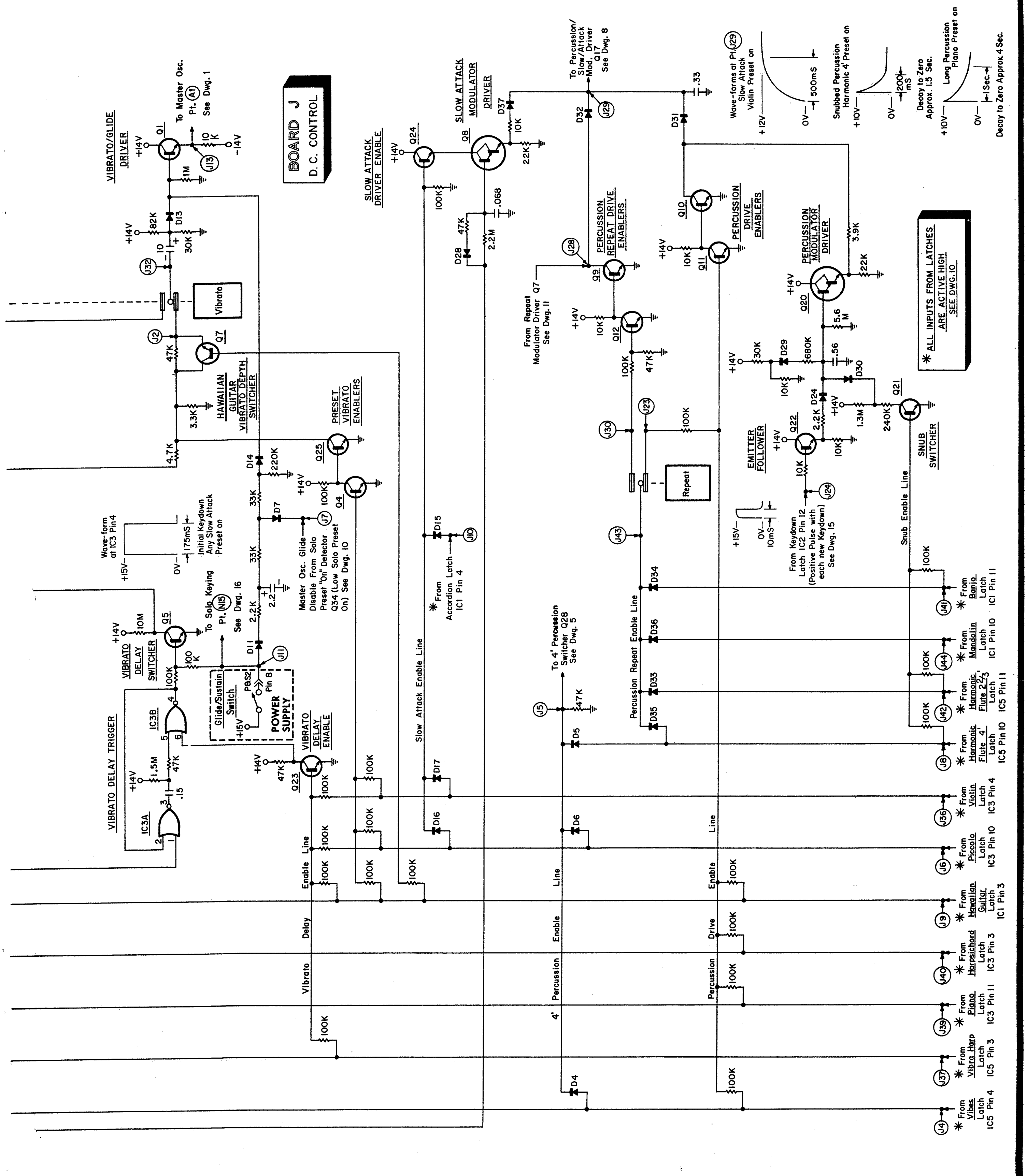
✱ Resistor tailored for 3.2V at collector of Q13 with negative meter lead connected to -15V terminal.

4' CAPACITOR CHART

Group	C1
F4-B4	.015
C5-F5	.01
F#5-B5	.0068
C6-F6	.0047
F#6-B6	.0033
C7-F7	.0022
F#7-C8	.0015

UPPER DIODE KEYING & DC CONTROL

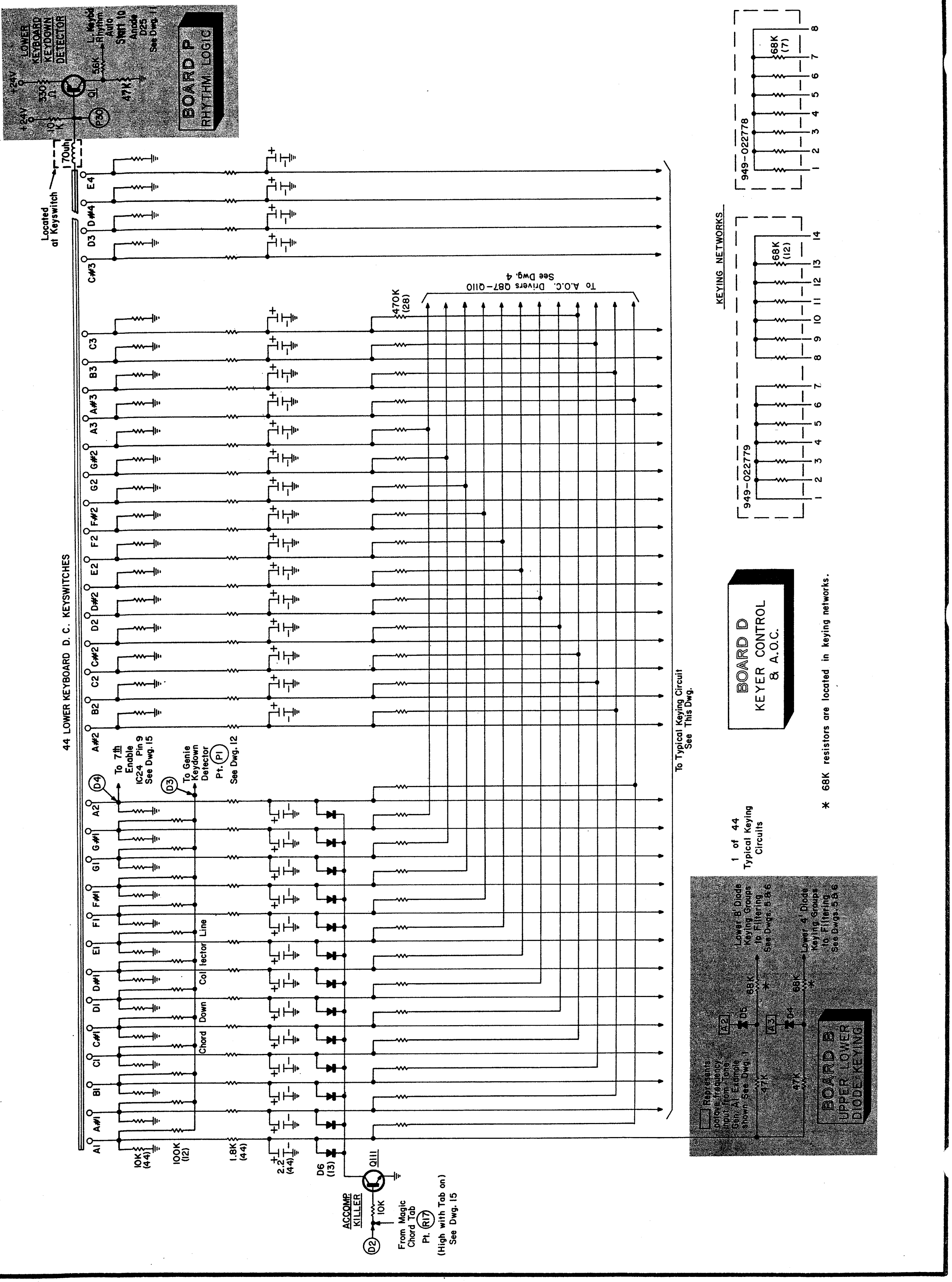
2

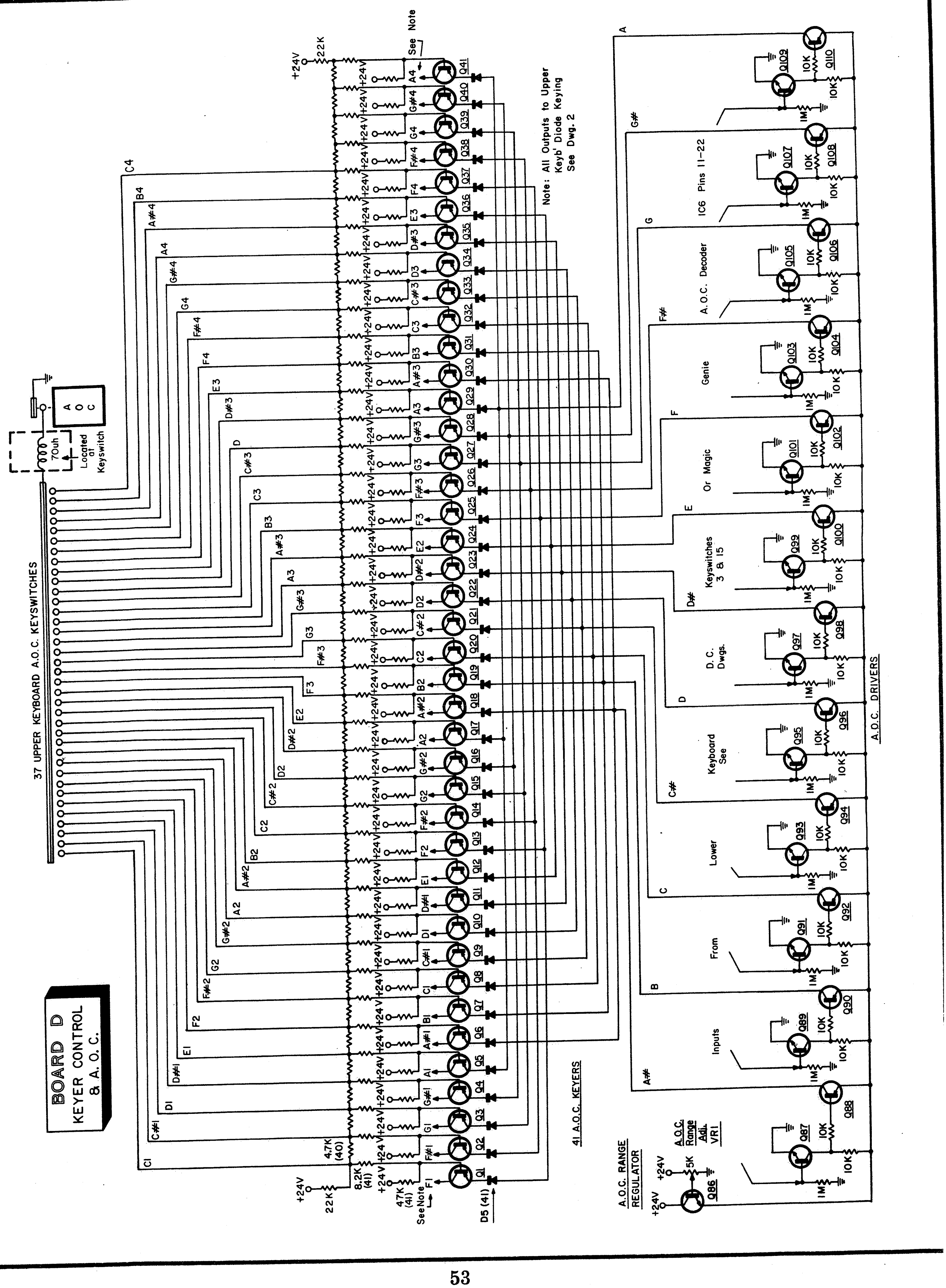


BOARD J
D. C. CONTROL
VIBRATO/GLIDE DRIVER
Q1
+14V
-14V
10 K
J13
To Master Osc. Pt. A1 See Dwg. 1
1M
82K
D13
30K
10
J32
Vibrato
J2
Q7
47K
HAWAIIAN GUITAR VIBRATO DEPTH SWITCHER
3.3K
4.7K
Wave-form at IC3 Pin4
+15V
0V
175mS
Initial Keydown Any Slow Attack Preset on
VIBRATO DELAY SWITCHER
10M
Q5
100 K
100K
To Solo Keying Pt. NJ5 See Dwg. 16
Glide/Sustain Switch
P&S2
Pin 8
J11
+15V
POWER SUPPLY
IC3B
VIBRATO DELAY TRIGGER
IC3A
1.5M
47K
.15
VIBRATO DELAY ENABLE
Q23
47K
D11
2.2K
2.2
33K
D7
J7
33K
D14
220K
PRESET VIBRATO ENABLERS
Q25
Q4
Master Osc. Glide Disable From Solo Preset "On" Detector Q34 (Low Solo Preset On) See Dwg. 10
SLOW ATTACK DRIVER ENABLE
Q24
100K
SLOW ATTACK MODULATOR DRIVER
Q8
D37
10K
22K
.068
47K
2.2M
D28
D15
J10
* From Accordion Latch IC1 Pin 4
Slow Attack Enable Line
D17
D16
To Percussion/ Slow/Attack Mod. Driver Q17 See Dwg. 8
D32
J29
.33
D31
J28
PERCUSSION REPEAT DRIVE ENABLERS
Q9
From Repeat Modulator Driver Q7 See Dwg. 11
Q12
10K
100K
47K
Q10
Q11
PERCUSSION DRIVE ENABLERS
J30
J23
100K
Repeat
J43
D34
D36
D33
D35
Percussion Repeat Enable Line
To 4' Percussion Switcher Q28 See Dwg. 5
J5
47K
D5
D6
D4
Wave-forms at Pt. J29 Slow Attack Violin Preset on
+12V
0V
500mS
Snubbed Percussion Harmonic 4' Preset on
+10V
200 mS
Decay to Zero Approx. 1.5 Sec.
Long Percussion Piano Preset on
1 Sec.
Decay to Zero Approx. 4 Sec.
PERCUSSION MODULATOR DRIVER
3.9K
22K
Q20
5.6 M
30K
D29
680K
.56
D30
D24
Q21
1.3M
240K
SNUB SWITCHER
EMITTER FOLLOWER
Q22
2.2K
10K
J24
+15V
0V
10mS
From Keydown Latch IC2 Pin 12 (Positive Pulse with each new Keydown) See Dwg. 15
Snub Enable Line
* ALL INPUTS FROM LATCHES ARE ACTIVE HIGH SEE DWG. 10
J41 * From Banjo Latch IC1 Pin 11
J44 * From Mandolin Latch IC1 Pin 10
J42 * From Harmonic Flute 2 2/3' Latch IC5 Pin 11
J8 * From Harmonic Flute 4' Latch IC5 Pin 10
J36 * From Violin Latch IC3 Pin 4
J6 * From Piccolo Latch IC3 Pin 10
J9 * From Hawaiian Guitar Latch IC1 Pin 3
J40 * From Harpsichord Latch IC3 Pin 3
J39 * From Piano Latch IC3 Pin 11
J37 * From Vibra Harp Latch IC5 Pin 3
J4 * From Vibes Latch IC5 Pin 4
Vibrato Delay Enable Line
4' Percussion Enable Line
Percussion Drive Enable Line

3

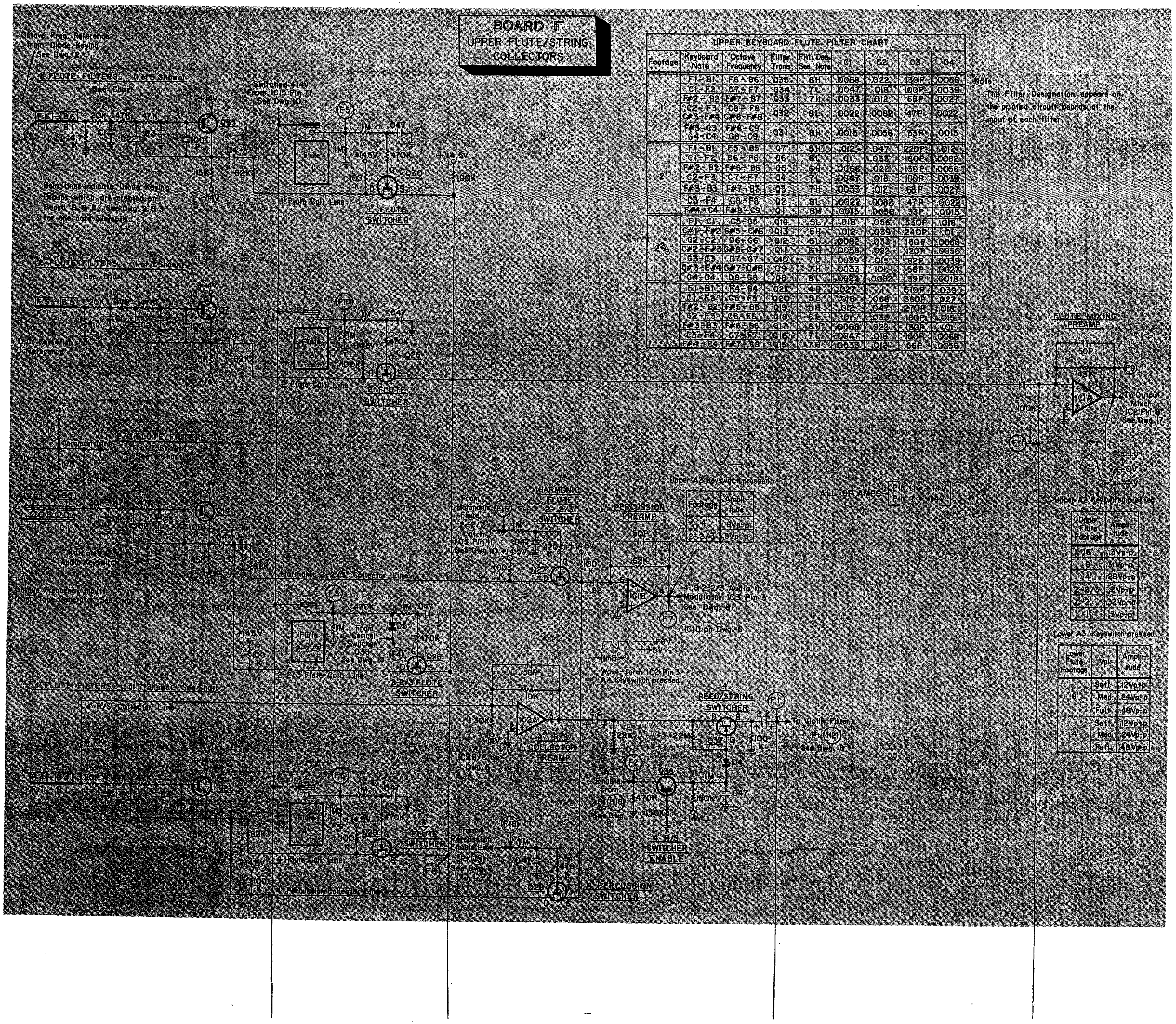
LOWER DIODE KEYING


LOWER KEYBOARD KEYDOWN DETECTOR
+24V
+24V
330 Ω
10K
Q1
P30
3.6K
47K
L. Keybd Rhythm Auto Start 10 Anode D25 See Dwg. 11
BOARD P RHYTHM LOGIC
170uh
Located at Keyswitch
E4
D#4
D3
C#3
C3
B3
A#3
A3
G#2
G2
F#2
F2
E2
D#2
D2
C#2
C2
B2
A#2
A2
G#1
G1
F#1
F1
E1
D#1
D1
C#1
C1
B1
A#1
A1
44 LOWER KEYBOARD D. C. KEYSWITCHES
470K (28)
To A.O.C. Drivers Q87-Q110 See Dwg. 4
D4
To 7th Enable IC24 Pin 9 See Dwg. 15
D3
To Genie Keydown Detector Pt. P1 See Dwg. 12
Chord Down Collector Line
10K (44)
100K (12)
1.8K (44)
2.2 (44)
D6 (13)
Q111
10K
ACCOMP KILLER
D2
From Magic Chord Tab Pt. R17 (High with Tab on) See Dwg. 15
To Typical Keying Circuit See This Dwg.
1 of 44 Typical Keying Circuits
Represents proper frequency input from Tone Gen. A1 Example shown See Dwg. 1
42
D6
68K
Lower 8' Diode Keying Groups to Filtering See Dwgs. 5 & 6
43
D4
68K
Lower 4' Diode Keying Groups to Filtering See Dwgs. 5 & 6
47K
47K
BOARD B UPPER LOWER DIODE KEYING
BOARD D KEYER CONTROL & A.O.C.
KEYING NETWORKS
949-022778
68K (7)
1 2 3 4 5 6 7 8
949-022779
68K (12)
1 2 3 4 5 6 7 8 9 10 11 12 13 14
* 68K resistors are located in keying networks.


BOARD D
KEYER CONTROL
& A.O.C.
37 UPPER KEYBOARD A.O.C. KEYSWITCHES
A
O
C
70uh
Located at Keyswitch
C1
C#1
D1
D#1
E1
F2
F#2
G2
G#2
A2
A#2
B2
C2
C#2
D2
D#2
E2
F3
F#3
G3
G#3
A3
A#3
B3
C3
C#3
D
D#3
E3
F4
F#4
G4
G#4
A4
A#4
B4
C4
+24V
22K
4.7K (40)
8.2K (41)
47K (41)
See Note
D5 (41)
41 A.O.C. KEYERS
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q30
Q31
Q32
Q33
Q34
Q35
Q36
Q37
Q38
Q39
Q40
Q41
F1
F#1
G1
G#1
A1
A#1
B1
C1
C#1
D1
D#1
E1
F2
F#2
G2
G#2
A2
A#2
B2
C2
C#2
D2
D#2
E2
F3
F#3
G3
G#3
A3
A#3
B3
C3
C#3
D3
D#3
E3
F4
F#4
G4
G#4
A4
See Note
Note: All Outputs to Upper Keyb' Diode Keying See Dwg. 2
A.O.C. RANGE REGULATOR
+24V
Q86
+24V
5K
A.O.C. Range Adj. VR1
A#
B
C
C#
D
D#
E
F
F#
G
G#
A
Inputs
From
Lower
Keyboard See
D.C. Dwgs.
Keyswitches 3 & 15
Or Magic
Genie
A.O.C. Decoder
IC6 Pins 11-22
Q87
Q88
Q89
Q90
Q91
Q92
Q93
Q94
Q95
Q96
Q97
Q98
Q99
Q100
Q101
Q102
Q103
Q104
Q105
Q106
Q107
Q108
Q109
Q110
10K
1M
A.O.C. DRIVERS

5

UPPER & LOWER KEYBOARD FLUTE FILTERS


BOARD F
UPPER FLUTE/STRING COLLECTORS
Octave Freq. Reference from Diode Keying See Dwg. 2
1' FLUTE FILTERS (1 of 5 Shown) See Chart
F6 - B6
F1 - B1
20K
47K
47K
4.7 K
C1
C2
C3
100 P
+14V
Q35
C4
15K
82K
-14V
Bold lines indicate Diode Keying Groups which are created on Board B & C. See Dwg. 2 & 3 for one note example.
Switched +14V From IC15 Pin 11 See Dwg. 10
F5
Flute 1'
1M
1M
.047
+14.5V
470K
100 K
Q30
G
D
S
+14.5V
100K
1' Flute Coll. Line
1' FLUTE SWITCHER
2' FLUTE FILTERS (1 of 7 Shown) See Chart
F5 - B5
F1 - B1
Q7
D.C. Keyswitch Reference
F10
Flute 2'
100K
Q25
2' Flute Coll. Line
2' FLUTE SWITCHER
2-2/3' FLUTE FILTERS (1 of 7 Shown) See Chart
+14V
10 K
Common Line
10
10K
4.7K
G5 - E5
F1 - C1
Q14
Indicates 2-2/3' Audio Keyswitch
Octave Frequency Inputs from Tone Generator See Dwg. 1
82K
180K
Harmonic 2-2/3' Collector Line
F3
470K
1M
.047
D5
From Cancel Switcher Q38 See Dwg. 10
F4
Flute 2-2/3'
470K
Q26
2-2/3' Flute Coll. Line
2-2/3' FLUTE SWITCHER
From Harmonic Flute 2-2/3' Latch IC5 Pin 11 See Dwg. 10
F16
HARMONIC FLUTE 2-2/3' SWITCHER
Q27
PERCUSSION PREAMP
50P
62K
.22
IC1B
4' & 2-2/3' Audio to Modulator IC3 Pin 3 See Dwg. 8
F7
IC1D on Dwg. 6
+6V
+5V
1mS
Wave-form IC2 Pin 3 A2 Keyswitch pressed
+V
0V
-V
Upper A2 Keyswitch pressed
4' FLUTE FILTERS (1 of 7 Shown) See Chart
4' R/S Collector Line
F4 - B4
F1 - B1
Q21
F6
Flute 4'
Q29
4' FLUTE SWITCHER
4' Flute Coll. Line
4' Percussion Collector Line
F8
From 4' Percussion Enable Line P1 J5 See Dwg. 2
F18
Q28
4' PERCUSSION SWITCHER
50P
10K
30K
IC2A
4' R/S COLLECTOR PREAMP
IC2B, C on Dwg. 6
2.2
22K
22M
Q37
D4
4' REED/STRING SWITCHER
F1
To Violin Filter P1 H21 See Dwg. 8
F2
4' Enable From P1 H18 See Dwg. 8
Q38
470K
150K
150K
4' R/S SWITCHER ENABLE
FLUTE MIXING PREAMP
50P
43K
100K
IC1A
F9
F11
To Output Mixer IC2 Pin 8 See Dwg. 17
ALL OP AMPS Pin 11 = +14V Pin 7 = -14V

UPPER KEYBOARD FLUTE FILTER CHART

Footage	Keyboard Note	Octave Frequency	Filter Trans.	Filt. Des. See Note	C1	C2	C3	C4
1'	F1 - B1	F6 - B6	Q35	6H	.0068	.022	130P	.0056
	C1 - F2	C7 - F7	Q34	7L	.0047	.018	100P	.0039
	F#2 - B2	F#7 - B7	Q33	7H	.0033	.012	68P	.0027
	C2 - F3 C#3 - F#4	C8 - F8 C#8 - F#8	Q32	8L	.0022	.0082	47P	.0022
	F#3 - C3 G4 - C4	F#8 - C9 G8 - C9	Q31	8H	.0015	.0056	33P	.0015
2'	F1 - B1	F5 - B5	Q7	5H	.012	.047	220P	.012
	C1 - F2	C6 - F6	Q6	6L	.01	.033	180P	.0082
	F#2 - B2	F#6 - B6	Q5	6H	.0068	.022	130P	.0056
	C2 - F3	C7 - F7	Q4	7L	.0047	.018	100P	.0039
	F#3 - B3	F#7 - B7	Q3	7H	.0033	.012	68P	.0027
	C3 - F4	C8 - F8	Q2	8L	.0022	.0082	47P	.0022
	F#4 - C4	F#8 - C9	Q1	8H	.0015	.0056	33P	.0015
2⅔'	F1 - C1	C5 - G5	Q14	5L	.018	.056	330P	.018
	C#1 - F#2	G#5 - C#6	Q13	5H	.012	.039	240P	.01
	G2 - C2	D6 - G6	Q12	6L	.0082	.033	160P	.0068
	C#2 - F#3	G#6 - C#7	Q11	6H	.0056	.022	120P	.0056
	G3 - C3	D7 - G7	Q10	7L	.0039	.015	82P	.0039
	C#3 - F#4	G#7 - C#8	Q9	7H	.0033	.01	56P	.0027
	G4 - C4	D8 - G8	Q8	8L	.0022	.0082	39P	.0018
4'	F1 - B1	F4 - B4	Q21	4H	.027	.1	510P	.039
	C1 - F2	C5 - F5	Q20	5L	.018	.068	360P	.027
	F#2 - B2	F#5 - B5	Q19	5H	.012	.047	270P	.018
	C2 - F3	C6 - F6	Q18	6L	.01	.033	180P	.015
	F#3 - B3	F#6 - B6	Q17	6H	.0068	.022	130P	.01
	C3 - F4	C7 - F7	Q16	7L	.0047	.018	100P	.0068
	F#4 - C4	F#7 - C8	Q15	7H	.0033	.012	56P	.0056

Note:
The Filter Designation appears on the printed circuit boards at the input of each filter.

Upper A2 Keyswitch pressed

Footage	Amplitude
4'	.8Vp-p
2-2/3'	.5Vp-p

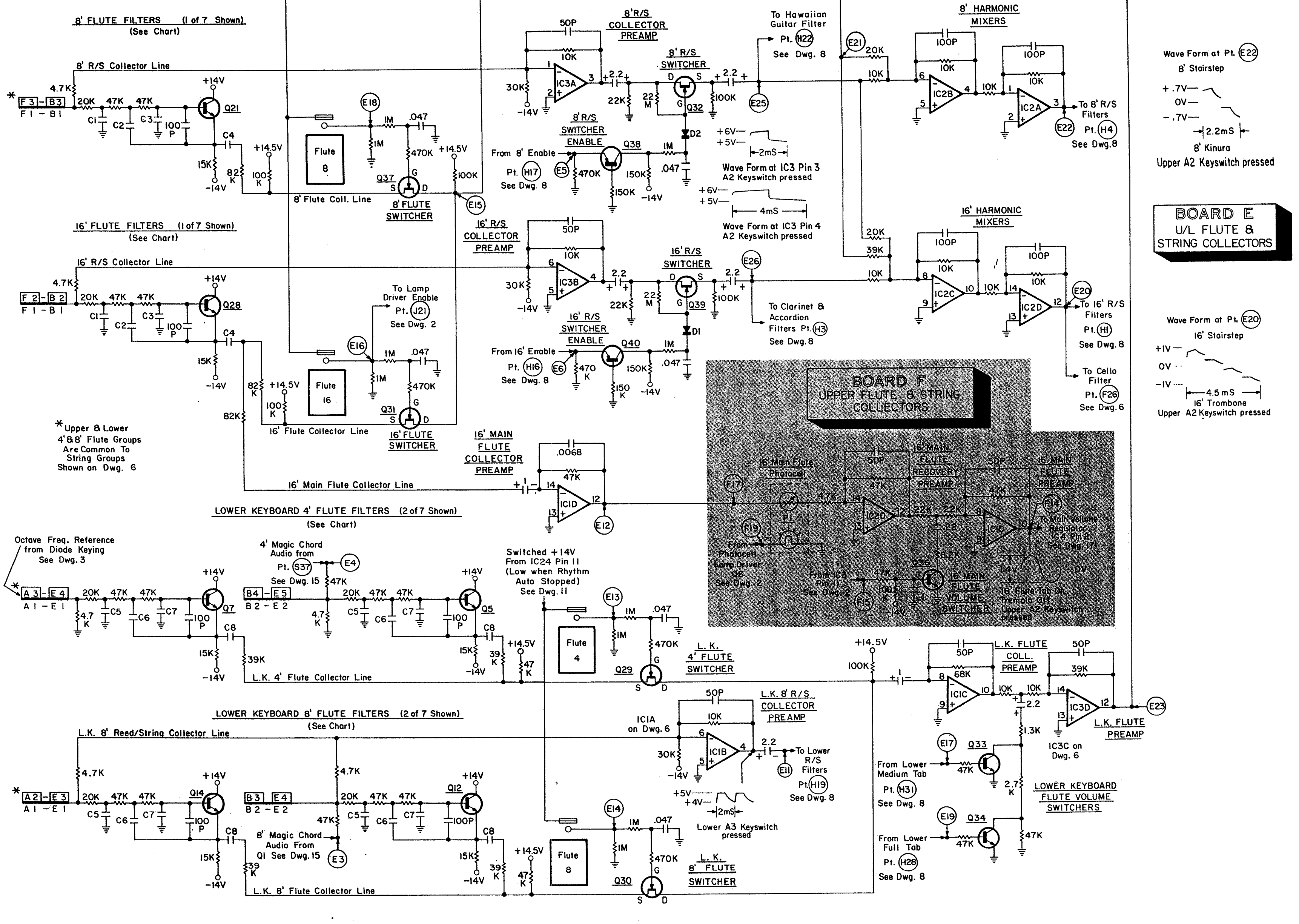
Upper A2 Keyswitch pressed

Upper Flute Footage	Amplitude
16'	.3Vp-p
8'	.31Vp-p
4'	.28Vp-p
2-2/3	.2Vp-p
2'	.32Vp-p
1'	.3Vp-p

Lower A3 Keyswitch pressed

Lower Flute Footage	Vol.	Amplitude
8'	Soft	.12Vp-p
	Med.	.24Vp-p
	Full	.48Vp-p
4'	Soft	.12Vp-p
	Med.	.24Vp-p
	Full	.48Vp-p

UPPER & LOWER KEYBOARD FLUTE FILTERS


8' FLUTE FILTERS (1 of 7 Shown)
(See Chart)
8' R/S Collector Line
F3-B3
F1 - B1
Q21
+14V
-14V
+14.5V
C1 C2 C3 C4
8' Flute Coll. Line
Flute 8
E18
Q37
8' FLUTE SWITCHER
E15
16' FLUTE FILTERS (1 of 7 Shown)
(See Chart)
16' R/S Collector Line
F2-B2
F1 - B1
Q28
To Lamp Driver Enable Pt. J21 See Dwg. 2
E16
Flute 16
Q31
16' Flute Collector Line
16' FLUTE SWITCHER
*Upper & Lower 4' & 8' Flute Groups Are Common To String Groups Shown on Dwg. 6
16' Main Flute Collector Line
8'R/S COLLECTOR PREAMP
IC3A
8' R/S SWITCHER
Q32
D2
E25
8' R/S SWITCHER ENABLE
Q38
From 8' Enable Pt. H17 See Dwg. 8
E5
Wave Form at IC3 Pin 3
A2 Keyswitch pressed
+6V
+5V
2mS
Wave Form at IC3 Pin 4
A2 Keyswitch pressed
4mS
16' R/S COLLECTOR PREAMP
IC3B
16' R/S SWITCHER
Q39
D1
E26
16' R/S SWITCHER ENABLE
Q40
From 16' Enable Pt. H16 See Dwg. 8
E6
16' MAIN FLUTE COLLECTOR PREAMP
IC1D
E12
To Hawaiian Guitar Filter Pt. H22 See Dwg. 8
To Clarinet & Accordion Filters Pt. H3 See Dwg. 8
E21
8' HARMONIC MIXERS
IC2B
IC2A
To 8' R/S Filters Pt. H4 See Dwg. 8
E22
16' HARMONIC MIXERS
IC2C
IC2D
E20
To 16' R/S Filters Pt. H1 See Dwg. 8
To Cello Filter Pt. F26 See Dwg. 6
Wave Form at Pt. E22
8' Stairstep
+.7V
0V
-.7V
2.2mS
8' Kinura
Upper A2 Keyswitch pressed
BOARD E
U/L FLUTE & STRING COLLECTORS
Wave Form at Pt. E20
16' Stairstep
+1V
0V
-1V
4.5mS
16' Trombone
Upper A2 Keyswitch pressed
BOARD F
UPPER FLUTE & STRING COLLECTORS
16' Main Flute Photocell
F17
P1
F19
From Photocell Lamp Driver Q6 See Dwg. 2
16' MAIN FLUTE RECOVERY PREAMP
IC2D
16' MAIN FLUTE PREAMP
IC1C
F14
To Main Volume Regulator IC4 Pin 2 See Dwg. 17
From IC3 Pin 11 See Dwg. 2
F15
Q36
16' MAIN FLUTE VOLUME SWITCHER
1.4V
0V
16' Flute Tab On, Tremolo Off Upper A2 Keyswitch pressed
LOWER KEYBOARD 4' FLUTE FILTERS (2 of 7 Shown)
(See Chart)
Octave Freq. Reference from Diode Keying See Dwg. 3
A3-E4
A1 - E1
Q7
4' Magic Chord Audio from Pt. S37 See Dwg. 15
E4
B4-E5
B2 - E2
Q5
C5 C6 C7 C8
L.K. 4' Flute Collector Line
Switched +14V From IC24 Pin 11 (Low when Rhythm Auto Stopped) See Dwg. 11
E13
Flute 4
Q29
L. K. 4' FLUTE SWITCHER
LOWER KEYBOARD 8' FLUTE FILTERS (2 of 7 Shown)
(See Chart)
L.K. 8' Reed/String Collector Line
A2-E3
A1 - E1
Q14
B3-E4
B2 - E2
Q12
8' Magic Chord Audio From Q1 See Dwg. 15
E3
L.K. 8' Flute Collector Line
E14
Flute 8
Q30
L. K. 8' FLUTE SWITCHER
IC1A on Dwg. 6
L.K. 8' R/S COLLECTOR PREAMP
IC1B
To Lower R/S Filters Pt. H19 See Dwg. 8
E11
+5V
+4V
2mS
Lower A3 Keyswitch pressed
L.K. FLUTE COLL. PREAMP
IC1C
L.K. FLUTE PREAMP
IC3D
E23
IC3C on Dwg. 6
E17
Q33
From Lower Medium Tab Pt. H31 See Dwg. 8
E19
Q34
From Lower Full Tab Pt. H28 See Dwg. 8
LOWER KEYBOARD FLUTE VOLUME SWITCHERS

UPPER KEYBOARD FLUTE FILTER CHART

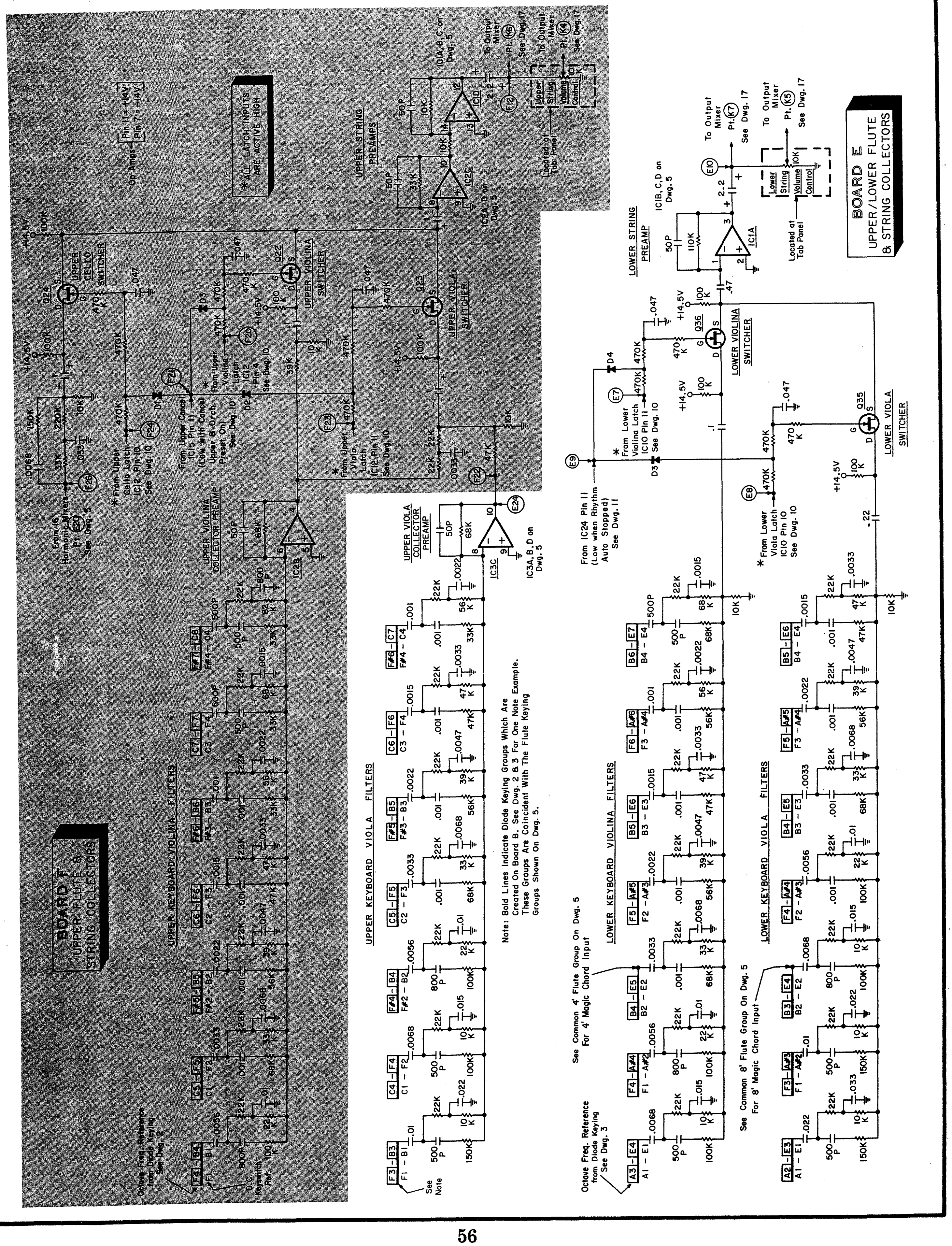
Footage	Keyboard Note	Octave Frequency	Filter	Filt. Des. See Note	C1	C2	C3	C4	Footage	Keyboard Note	Octave Frequency	Filter	Filt. Des. See Note	C1	C2	C3	C4
8'	F1 - B1	F3 - B3	Q21	3H	.056	.18	.001	.047	16'	F1 - B1	F2 - B2	Q28	2H	.1	.39	.0022	.1
	C1 - F2	C4 - F4	Q20	4L	.039	.15	680P	.033		C1 - F2	C3 - F3	Q27	3L	.082	.27	.0015	.068
	F#2 - B2	F#4 - B4	Q19	4H	.027	.1	510P	.022		F#2 - B2	F#3 - B3	Q26	3H	.056	.18	.001	.047
	C2 - F3	C5 - F5	Q18	5L	.018	.068	360P	.018		C2 - F3	C4 - F4	Q25	4L	.039	.15	680P	.033
	F#3 - B3	F#5 - B5	Q17	5H	.012	.047	270P	.012		F#3 - B3	F#4 - B4	Q24	4H	.027	.1	510P	.022
	C3 - F4	C6 - F6	Q16	6L	.01	.033	180P	.0082		C3 - F4	C5 - F5	Q23	5L	.018	.068	360P	.018
	F#4 - C4	F#6 - C7	Q15	6H	.0068	.022	120P	.0056		F#4 - C4	F#5 - C6	Q22	5H	.012	.047	240P	.012

Note
The Filter Designation appears on the printed circuit boards at the input of each filter.

LOWER KEYBOARD FLUTE FILTER CHART

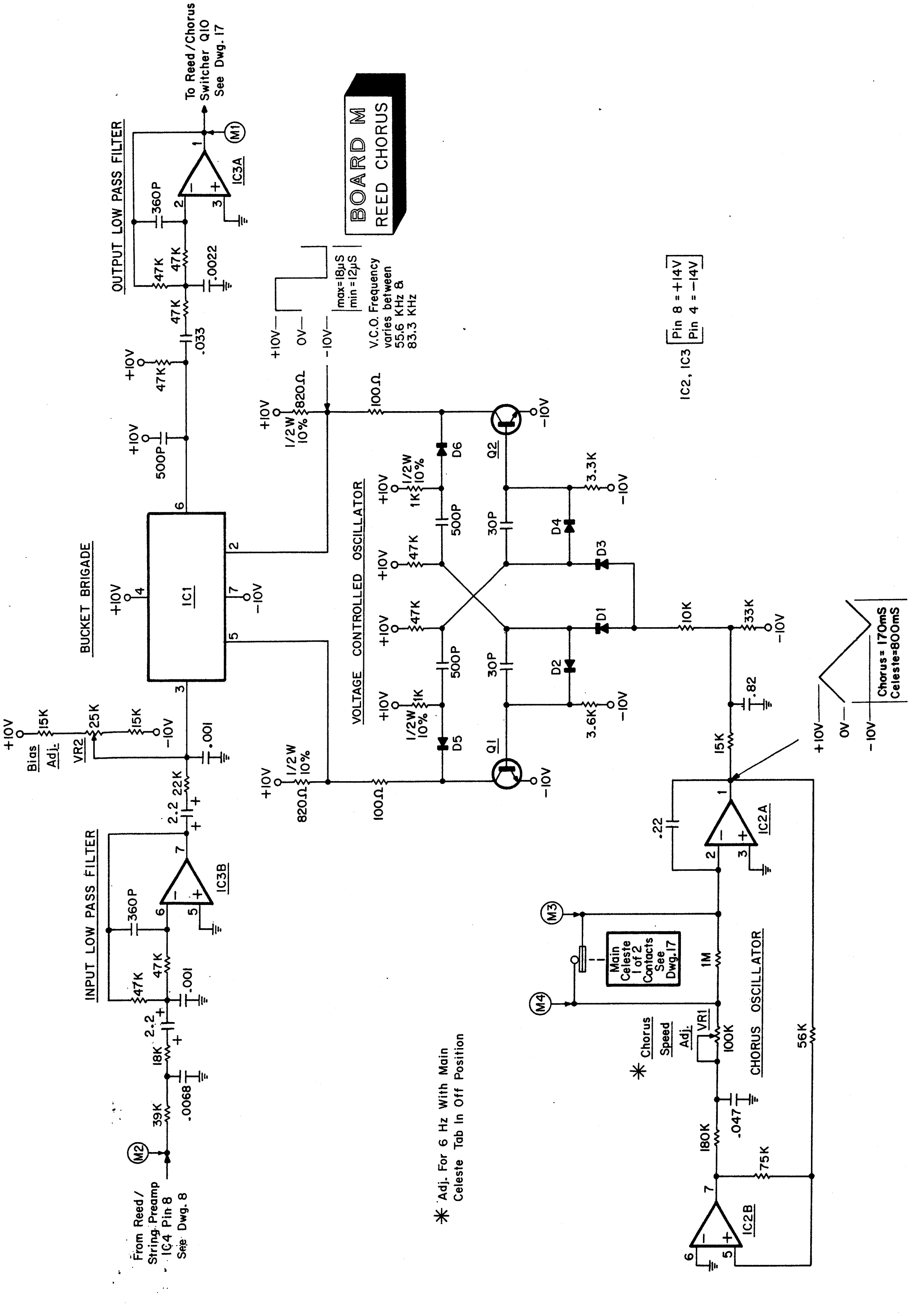
Footage	Keyboard Note	Octave Frequency	Filter	Filt. Des. See Note	C5	C6	C7	C8	Footage	Keyboard Note	Octave Frequency	Filter	Filt. Des. See Note	C5	C6	C7	C8
4'	A1 - E1	A3 - E4	Q7	4L	.039	.15	750P	.047	8'	A1 - E1	A2 - E3	Q14	3L	.082	.27	.0015	.082
	F1 - A#2	F4 - A#4	Q6	4H	.027	.1	560P	.027		F1 - A#2	F3 - A#3	Q13	3H	.056	.22	.0012	.056
	B2 - E2	B4 - E5	Q5	5L	.022	.068	390P	.022		B2 - E2	B3 - E4	Q12	4L	.039	.15	750P	.039
	F2 - A#3	F5 - A#5	Q4	5H	.015	.047	270P	.015		F2 - A#3	F4 - A#4	Q11	4H	.027	.1	560P	.027
	B3 - E3	B5 - E6	Q3	6L	.01	.033	200P	.01		B3 - E3	B4 - E5	Q10	5L	.022	.068	390P	.022
	F3 - A#4	F6 - A#6	Q2	6H	.0068	.027	130P	.0068		F3 - A#4	F5 - A#5	Q9	5H	.015	.047	270P	.015
	B4 - E4	B6 - E7	Q1	7L	.0047	.018	100P	.0056		B4 - E4	B5 - E6	Q8	6L	.01	.033	200P	.01

6 UPPER & LOWER KEYBOARD SYMPHONIC STRING FILTERS


BOARD F UPPER FLUTE & STRING COLLECTORS
BOARD E UPPER/LOWER FLUTE & STRING COLLECTORS
*ALL LATCH INPUTS ARE ACTIVE HIGH
Op Amps: Pin 11 = +14V, Pin 7 = -14V
UPPER STRING PREAMPS
UPPER CELLO SWITCHER
UPPER VIOLINA SWITCHER
UPPER VIOLA SWITCHER
UPPER VIOLINA COLLECTOR PREAMP
UPPER VIOLA COLLECTOR PREAMP
UPPER KEYBOARD VIOLINA FILTERS
UPPER KEYBOARD VIOLA FILTERS
LOWER KEYBOARD VIOLINA FILTERS
LOWER KEYBOARD VIOLA FILTERS
LOWER STRING PREAMP
LOWER VIOLINA SWITCHER
LOWER VIOLA SWITCHER
To Output Mixer Pt. K6 See Dwg. 17
To Output Mixer Pt. K4 See Dwg. 17
To Output Mixer Pt. K7 See Dwg. 17
To Output Mixer Pt. K5 See Dwg. 17
Upper String Volume Control
Lower String Volume Control
Located at Tab Panel
IC1A, B, C on Dwg. 5
IC2A, D on Dwg. 5
IC3A, B, D on Dwg. 5
IC1B, C, D on Dwg. 5
IC1A
IC1D
IC2B
IC2C
IC3C
Q22
Q23
Q24
Q35
Q36
From 16' Harmonic Mixers Pt. E20 See Dwg. 5
*From Upper Cello Latch IC12 Pin 10 See Dwg. 10
From Upper Cancel IC15 Pin 11 (Low with Cancel Upper & Orch. Preset On) See Dwg. 10
*From Upper Violina Latch IC12 Pin 4 See Dwg. 10
*From Upper Viola Latch IC12 Pin 11 See Dwg. 10
From IC24 Pin 11 (Low when Rhythm Auto Stopped) See Dwg. 11
*From Lower Violina Latch IC10 Pin 11 See Dwg. 10
*From Lower Viola Latch IC10 Pin 10 See Dwg. 10
Octave Freq. Reference from Diode Keying See Dwg. 2
D.C. Keyswitch Ref.
See Note
Octave Freq. Reference from Diode Keying See Dwg. 3
See Common 4' Flute Group On Dwg. 5 For 4' Magic Chord Input
See Common 8' Flute Group On Dwg. 5 For 8' Magic Chord Input
F4-B4 F1-B1
C5-F5 C1-F2
F#5-B5 F#2-B2
C6-F6 C2-F3
F#6-B6 F#3-B3
C7-F7 C3-F4
F#7-C8 F#4-C4
F3-B3 F1-B1
C4-F4 C1-F2
F#4-B4 F#2-B2
C5-F5 C2-F3
F#5-B5 F#3-B3
C6-F6 C3-F4
F#6-C7 F#4-C4
A3-E4 A1-E1
F4-A#4 F1-A#2
B4-E5 B2-E2
F5-A#5 F2-A#3
B5-E6 B3-E3
F6-A#6 F3-A#4
B6-E7 B4-E4
A2-E3 A1-E1
F3-A#3 F1-A#2
B3-E4 B2-E2
F4-A#4 F2-A#3
B4-E5 B3-E3
F5-A#5 F3-A#4
B5-E6 B4-E4
+14.5V
F12
F20
F21
F22
F23
F24
F26
E7
E8
E9
E10
E24
D1
D2
D3
D4

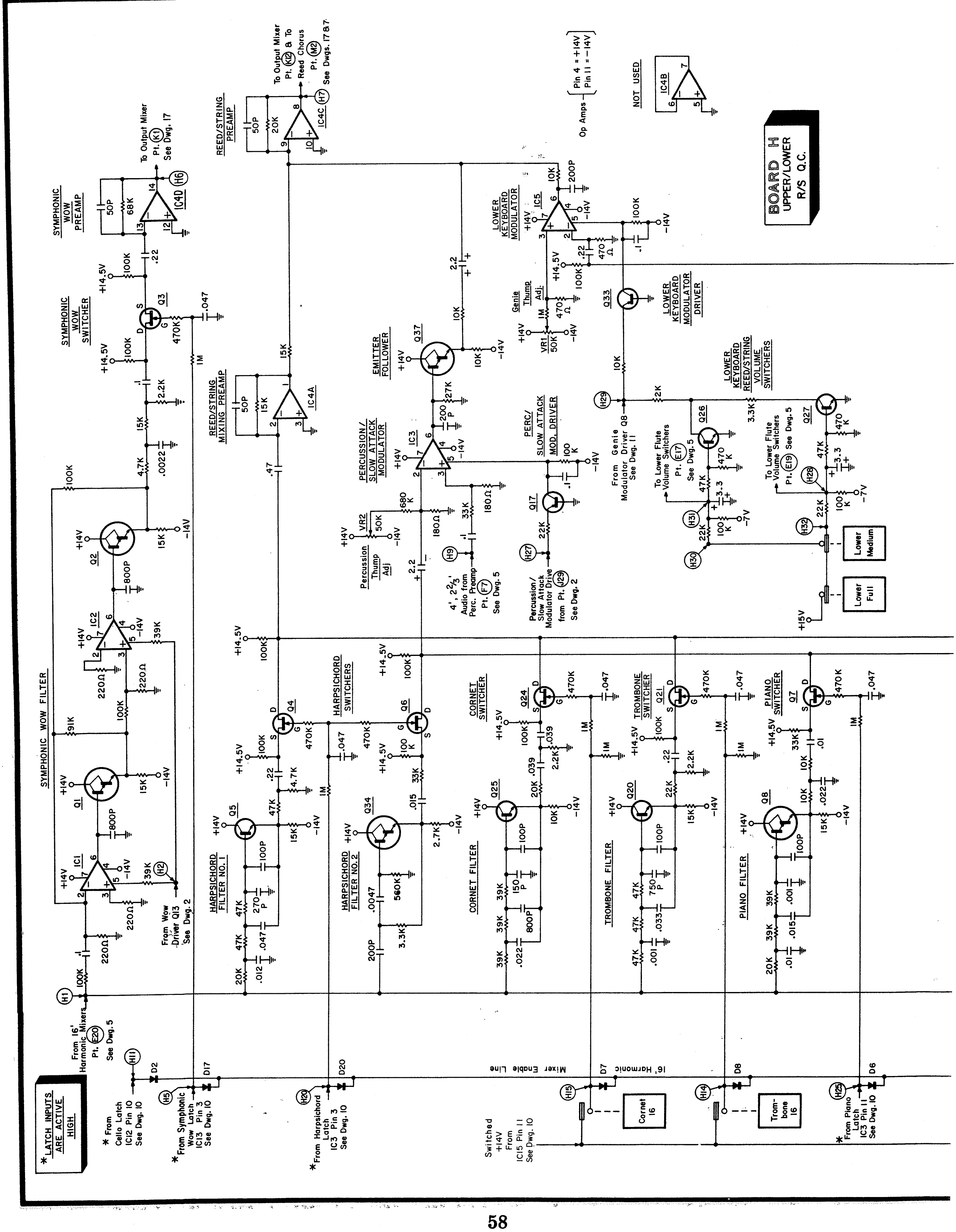
Note: Bold Lines Indicate Diode Keying Groups Which Are Created On Board B. See Dwg. 2 & 3 For One Note Example. These Groups Are Coincident With The Flute Keying Groups Shown On Dwg. 5.

REED CHORUS


BOARD M
REED CHORUS
OUTPUT LOW PASS FILTER
To Reed/Chorus Switcher Q10 See Dwg. 17
M1
IC3A
360P
47K
47K
.0022
47K
.033
+10V
47K
+10V
500P
BUCKET BRIGADE
IC1
+10V
-10V
Bias Adj. VR2
+10V
15K
25K
15K
-10V
.001
2.2
22K
INPUT LOW PASS FILTER
IC3B
360P
47K
47K
.001
2.2
18K
39K
.0068
M2
From Reed/String Preamp IC4 Pin 8 See Dwg. 8
+10V
0V
-10V
max=18μS
min=12μS
V.C.O. Frequency varies between 55.6 KHz & 83.3 KHz
VOLTAGE CONTROLLED OSCILLATOR
1/2W 10%
820Ω
100Ω
D6
D5
1K
500P
47K
Q1
Q2
30P
3.3K
3.6K
D1
D2
D3
D4
10K
33K
.82
15K
IC2, IC3 Pin 8 = +14V Pin 4 = -14V
Chorus = 170mS
Celeste = 800mS
IC2A
.22
M3
M4
Main Celeste 1 of 2 Contacts See Dwg. 17
1M
CHORUS OSCILLATOR
Chorus Speed Adj. VR1
100K
56K
.047
180K
75K
IC2B
* Adj. For 6 Hz With Main Celeste Tab In Off Position

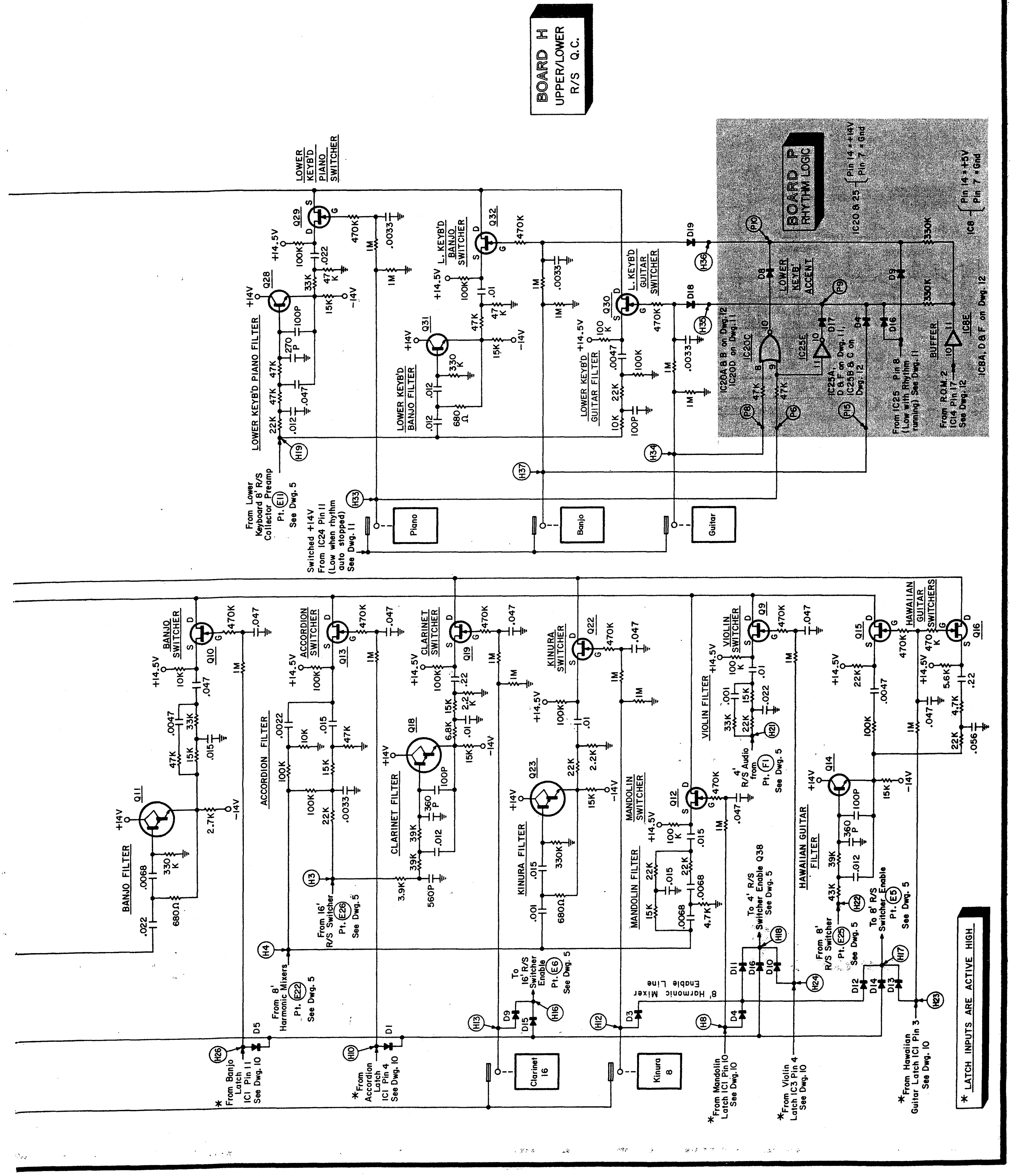
8

REED/STRING QUALITY CONTROL



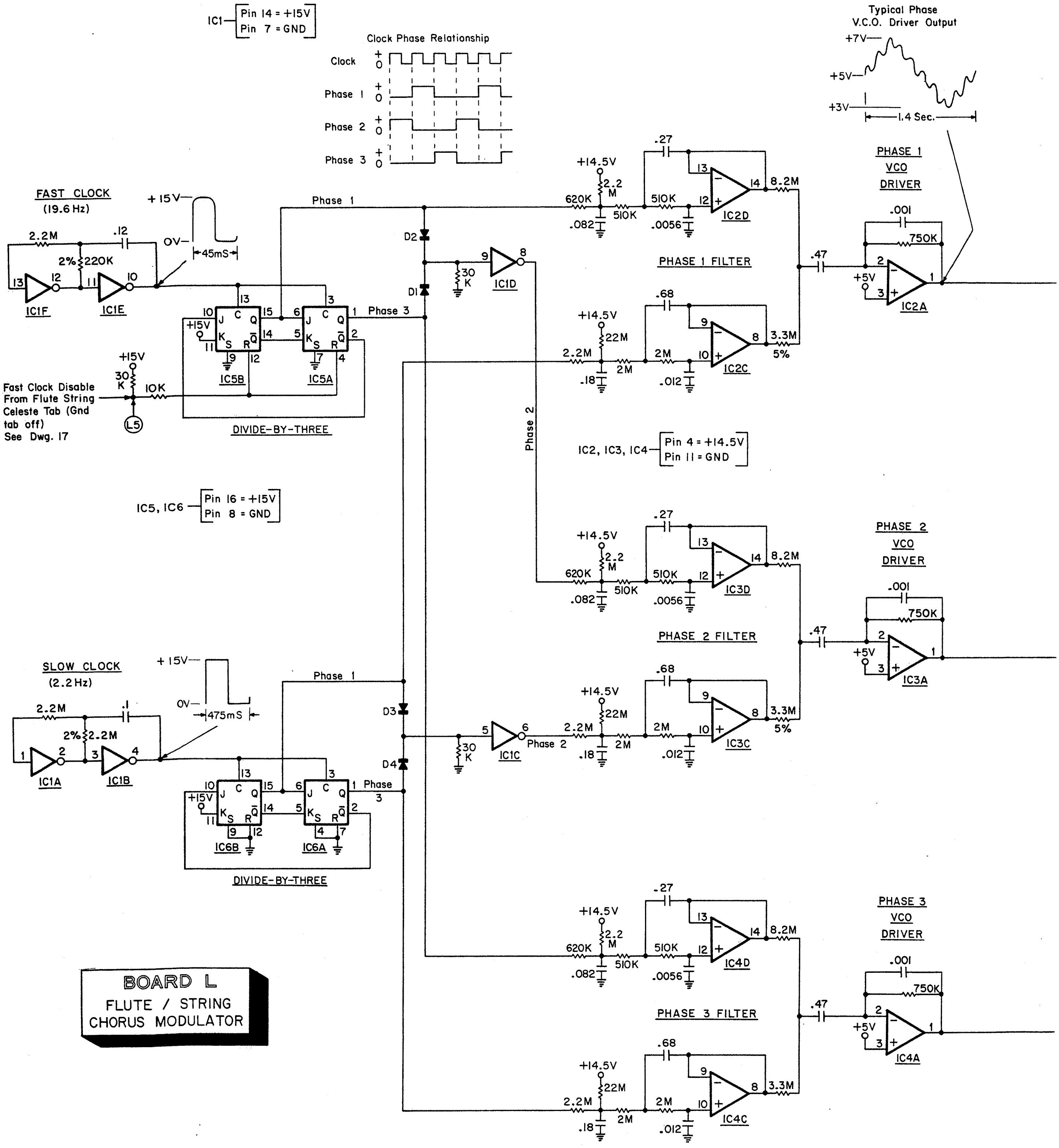
BOARD H
UPPER/LOWER
R/S Q.C.
*LATCH INPUTS ARE ACTIVE HIGH
SYMPHONIC WOW FILTER
SYMPHONIC WOW SWITCHER
SYMPHONIC WOW PREAMP
REED/STRING PREAMP
REED/STRING MIXING PREAMP
EMITTER FOLLOWER
PERCUSSION/SLOW ATTACK MODULATOR
PERC/SLOW ATTACK MOD. DRIVER
LOWER KEYBOARD MODULATOR
LOWER KEYBOARD MODULATOR DRIVER
LOWER KEYBOARD REED/STRING VOLUME SWITCHERS
NOT USED
Op Amps – Pin 4 = +14V, Pin 11 = –14V
To Output Mixer Pt. K1 See Dwg. 17
To Output Mixer Pt. K12 & To Reed Chorus Pt. M2 See Dwgs. 17 & 7
HARPSICHORD SWITCHERS
HARPSICHORD FILTER NO. 1
HARPSICHORD FILTER NO. 2
CORNET SWITCHER
CORNET FILTER
TROMBONE SWITCHER
TROMBONE FILTER
PIANO SWITCHER
PIANO FILTER
Percussion Thump Adj
Genie Thump Adj.
4', 2 2/3' Audio from Perc. Preamp Pt. F7 See Dwg. 5
Percussion/Slow Attack Modulator Drive from Pt. J29 See Dwg. 2
From Genie Modulator Driver Q8 See Dwg. 11
To Lower Flute Volume Switchers Pt. E17 See Dwg. 5
To Lower Flute Volume Switchers Pt. E19 See Dwg. 5
Lower Medium
Lower Full
From Wow Driver Q13 See Dwg. 2
From 16' Harmonic Mixers Pt. E20 See Dwg. 5
* From Cello Latch IC12 Pin 10 See Dwg. 10
* From Symphonic Wow Latch IC13 Pin 3 See Dwg. 10
* From Harpsichord Latch IC3 Pin 3 See Dwg. 10
Switched +14V From IC15 Pin 11 See Dwg. 10
16' Harmonic Mixer Enable Line
Cornet 16
Trom-bone 16
* From Piano Latch IC3 Pin 11 See Dwg. 10

REED/STRING QUALITY CONTROL

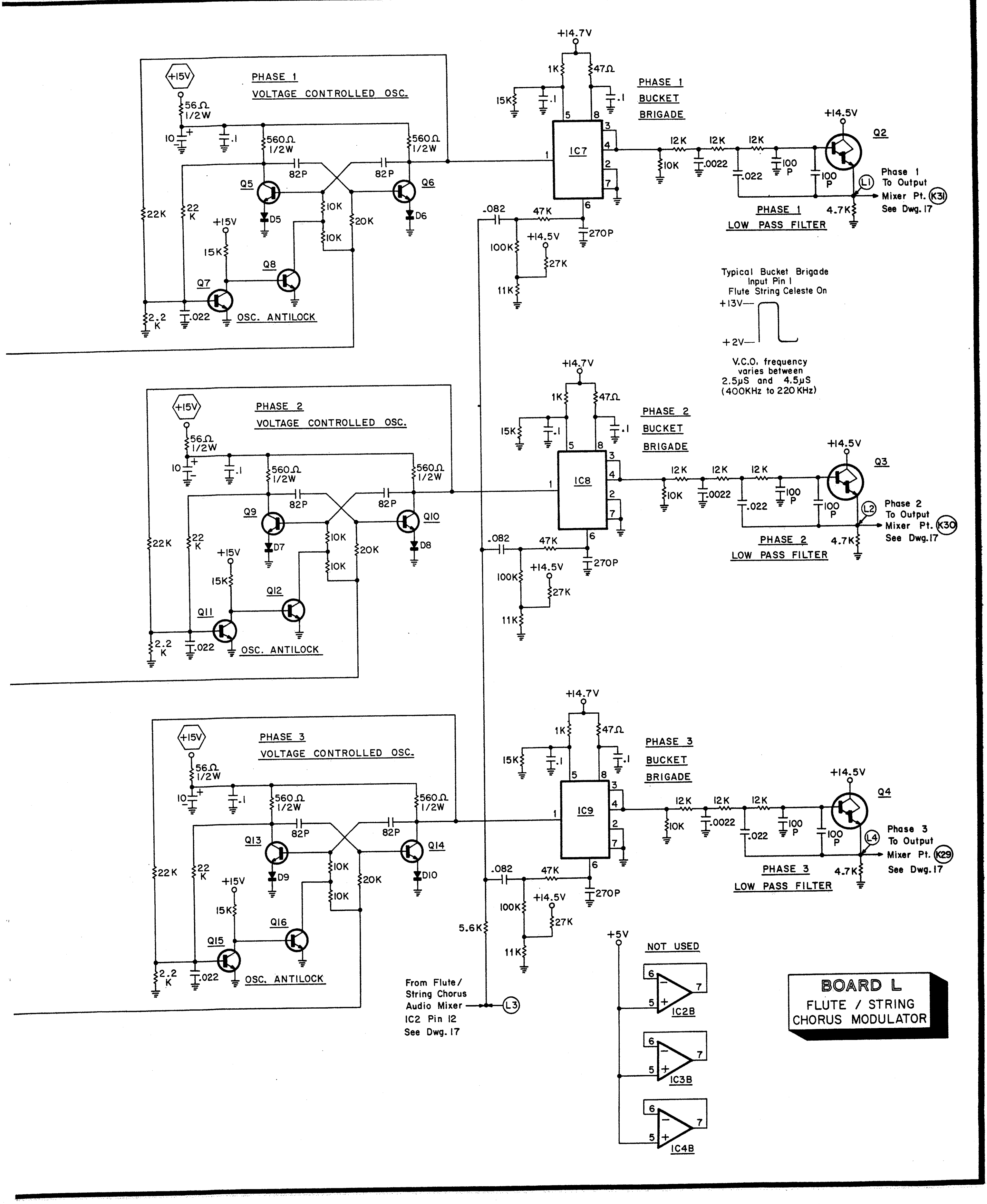

BOARD H
UPPER/LOWER
R/S Q.C.
BOARD P
RHYTHM LOGIC
LOWER KEYB'D PIANO SWITCHER
LOWER KEYB'D PIANO FILTER
L. KEYB'D BANJO SWITCHER
LOWER KEYB'D BANJO FILTER
L. KEYB'D GUITAR SWITCHER
LOWER KEYB'D GUITAR FILTER
LOWER KEYB'D ACCENT
BUFFER
IC20 & 25 Pin 14 = +14V Pin 7 = Gnd
IC8 Pin 14 = +5V Pin 7 = Gnd
IC20A & B on Dwg. 12 IC20D on Dwg. 11
IC25A, D & F on Dwg. 11, IC25B & C on Dwg. 12
IC8A, D & F on Dwg. 12
From IC25 Pin 8 (Low with Rhythm running) See Dwg. 11
From R.O.M. 2 IC14 Pin 17 See Dwg. 12
From Lower Keyboard 8' R/S Collector Preamp Pt. E11 See Dwg. 5
Switched +14V From IC24 Pin 11 (Low when rhythm auto stopped) See Dwg. 11
Piano
Banjo
Guitar
BANJO FILTER
BANJO SWITCHER
ACCORDION FILTER
ACCORDION SWITCHER
CLARINET FILTER
CLARINET SWITCHER
KINURA FILTER
KINURA SWITCHER
MANDOLIN FILTER
MANDOLIN SWITCHER
VIOLIN FILTER
VIOLIN SWITCHER
HAWAIIAN GUITAR FILTER
HAWAIIAN GUITAR SWITCHERS
4' R/S Audio from Pt. F1 See Dwg. 5
From 16' R/S Switcher Pt. E26 See Dwg. 5
From 8' Harmonic Mixers Pt. E22 See Dwg. 5
To 16' R/S Switcher Enable Pt. E6 See Dwg. 5
8' Harmonic Mixer Enable Line
To 4' R/S Switcher Enable Q38 See Dwg. 5
From 8' R/S Switcher Pt. E25 See Dwg. 5
To 8' R/S Switcher Enable Pt. E5 See Dwg. 5
Clarinet 16
Kinura 8
*From Banjo Latch IC1 Pin 11 See Dwg. 10
*From Accordion Latch IC1 Pin 4 See Dwg. 10
*From Mandolin Latch IC1 Pin 10 See Dwg. 10
*From Violin Latch IC3 Pin 4 See Dwg. 10
*From Hawaiian Guitar Latch IC1 Pin 3 See Dwg. 10
* LATCH INPUTS ARE ACTIVE HIGH

9

FLUTE & STRING CHORUS MODULATOR


IC1 Pin 14 = +15V Pin 7 = GND
Clock Phase Relationship
Clock
Phase 1
Phase 2
Phase 3
+
0
Typical Phase V.C.O. Driver Output
+7V
+5V
+3V
1.4 Sec.
FAST CLOCK (19.6 Hz)
2.2M
.12
2% 220K
IC1F
IC1E
+15V
0V
45mS
Phase 1
Phase 3
D1
D2
IC1D
30 K
IC5B
IC5A
DIVIDE-BY-THREE
Fast Clock Disable From Flute String Celeste Tab (Gnd tab off) See Dwg. 17
30 K
10K
L5
IC5, IC6 Pin 16 = +15V Pin 8 = GND
IC2, IC3, IC4 Pin 4 = +14.5V Pin 11 = GND
+14.5V
2.2 M
620K
.082
510K
.0056
.27
8.2M
IC2D
PHASE 1 FILTER
22M
2.2M
.18
2M
.012
.68
3.3M 5%
IC2C
PHASE 1 VCO DRIVER
.001
750K
.47
+5V
IC2A
Phase 2
IC3D
PHASE 2 FILTER
IC3C
PHASE 2 VCO DRIVER
IC3A
SLOW CLOCK (2.2 Hz)
2.2M
.1
2% 2.2M
IC1A
IC1B
475mS
D3
D4
IC1C
IC6B
IC6A
DIVIDE-BY-THREE
IC4D
PHASE 3 FILTER
IC4C
PHASE 3 VCO DRIVER
IC4A
BOARD L
FLUTE / STRING CHORUS MODULATOR

FLUTE & STRING CHORUS MODULATOR


+15V
PHASE 1
VOLTAGE CONTROLLED OSC.
56Ω
1/2W
10
.1
560Ω
1/2W
82P
Q5
Q6
D5
D6
10K
20K
22K
22
K
+15V
15K
Q8
Q7
2.2
K
.022
OSC. ANTILOCK
+14.7V
1K
47Ω
15K
.1
PHASE 1
BUCKET
BRIGADE
IC7
1
2
3
4
5
6
7
8
12K
10K
.0022
.022
100
P
+14.5V
Q2
L1
Phase 1
To Output
Mixer Pt. K31
See Dwg. 17
PHASE 1
LOW PASS FILTER
4.7K
.082
47K
100K
+14.5V
27K
270P
11K
Typical Bucket Brigade
Input Pin 1
Flute String Celeste On
+13V
+2V
V.C.O. frequency
varies between
2.5μS and 4.5μS
(400KHz to 220KHz)
PHASE 2
VOLTAGE CONTROLLED OSC.
Q9
Q10
D7
D8
Q11
Q12
PHASE 2
BUCKET
BRIGADE
IC8
Q3
L2
Phase 2
To Output
Mixer Pt. K30
See Dwg. 17
PHASE 2
LOW PASS FILTER
PHASE 3
VOLTAGE CONTROLLED OSC.
Q13
Q14
D9
D10
Q15
Q16
PHASE 3
BUCKET
BRIGADE
IC9
Q4
L4
Phase 3
To Output
Mixer Pt. K29
See Dwg. 17
PHASE 3
LOW PASS FILTER
5.6K
From Flute/
String Chorus
Audio Mixer
IC2 Pin 12
See Dwg. 17
L3
+5V
NOT USED
IC2B
IC3B
IC4B
BOARD L
FLUTE / STRING
CHORUS MODULATOR

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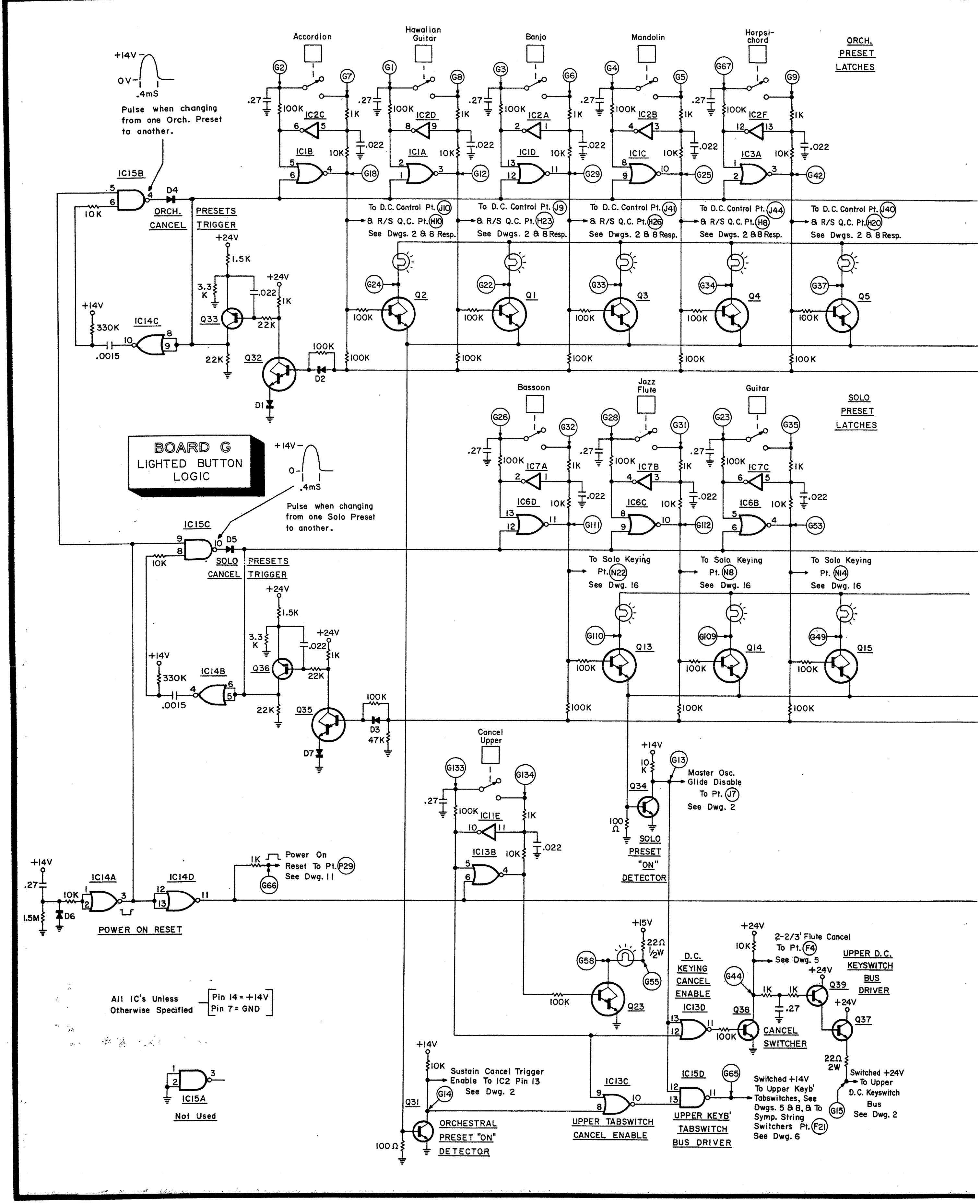
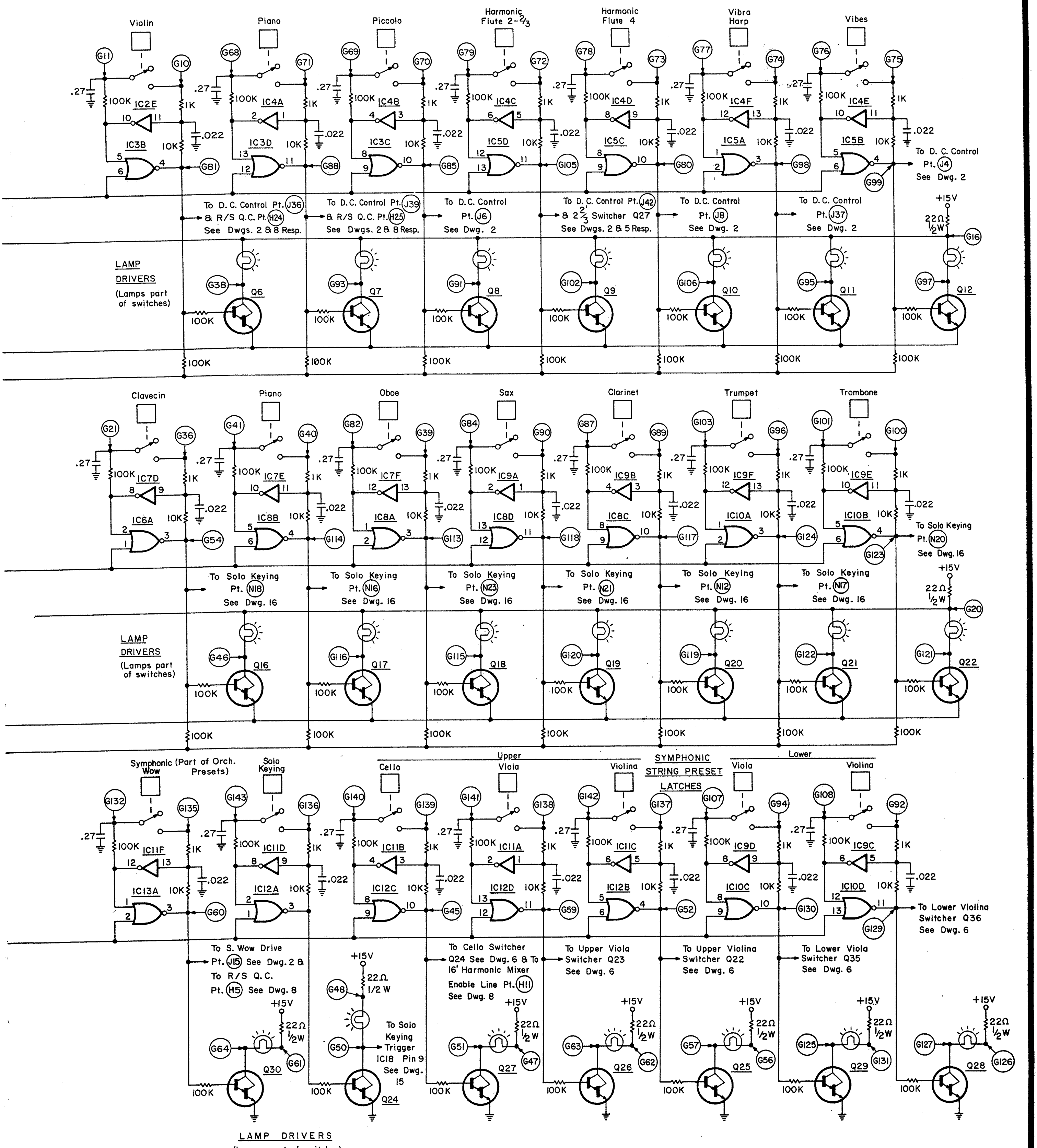
LIGHTED BUTTON LOGIC


Accordion
Hawaiian Guitar
Banjo
Mandolin
Harpsi-chord
ORCH. PRESET LATCHES
+14V
0V
.4mS
Pulse when changing from one Orch. Preset to another.
G2
G7
G1
G8
G3
G6
G4
G5
G67
G9
IC2C
IC2D
IC2A
IC2B
IC2F
IC1B
IC1A
IC1D
IC1C
IC3A
G18
G12
G29
G25
G42
.27
100K
1K
10K
.022
IC15B
D4
10K
ORCH. CANCEL
PRESETS TRIGGER
To D.C. Control Pt. J10 & R/S Q.C. Pt. H10 See Dwgs. 2 & 8 Resp.
To D.C. Control Pt. J9 & R/S Q.C. Pt. H23 See Dwgs. 2 & 8 Resp.
To D.C. Control Pt. J41 & R/S Q.C. Pt. H26 See Dwgs. 2 & 8 Resp.
To D.C. Control Pt. J44 & R/S Q.C. Pt. H8 See Dwgs. 2 & 8 Resp.
To D.C. Control Pt. J40 & R/S Q.C. Pt. H20 See Dwgs. 2 & 8 Resp.
+24V
1.5K
3.3K
.022
22K
Q33
IC14C
330K
.0015
22K
Q32
D1
100K
D2
G24
G22
G33
G34
G37
Q2
Q1
Q3
Q4
Q5
Bassoon
Jazz Flute
Guitar
SOLO PRESET LATCHES
G26
G32
G28
G31
G23
G35
IC7A
IC7B
IC7C
IC6D
IC6C
IC6B
G111
G112
G53
BOARD G
LIGHTED BUTTON LOGIC
Pulse when changing from one Solo Preset to another.
IC15C
D5
SOLO CANCEL
PRESETS TRIGGER
To Solo Keying Pt. N22 See Dwg. 16
To Solo Keying Pt. N8 See Dwg. 16
To Solo Keying Pt. N14 See Dwg. 16
G110
G109
G49
Q13
Q14
Q15
IC14B
Q36
Q35
D3
47K
D7
Cancel Upper
G133
G134
IC11E
IC13B
Master Osc. Glide Disable To Pt. J7 See Dwg. 2
G13
Q34
100 Ω
SOLO PRESET "ON" DETECTOR
1.5M
D6
IC14A
IC14D
POWER ON RESET
Power On Reset To Pt. P29 See Dwg. 11
G66
+15V
22Ω 1/2W
G58
G55
Q23
D.C. KEYING CANCEL ENABLE
IC13D
2-2/3' Flute Cancel To Pt. F4 See Dwg. 5
G44
Q38
Q39
UPPER D.C. KEYSWITCH BUS DRIVER
Q37
CANCEL SWITCHER
22Ω 2W
Switched +24V To Upper D.C. Keyswitch Bus See Dwg. 2
G15
All IC's Unless Otherwise Specified
Pin 14 = +14V
Pin 7 = GND
IC15A
Not Used
Sustain Cancel Trigger Enable To IC2 Pin 13 See Dwg. 2
G14
Q31
ORCHESTRAL PRESET "ON" DETECTOR
IC13C
UPPER TABSWITCH CANCEL ENABLE
IC15D
G65
UPPER KEYB' TABSWITCH BUS DRIVER
Switched +14V To Upper Keyb' Tabswitches, See Dwgs. 5 & 8, & To Symp. String Switchers Pt. F21 See Dwg. 6

LIGHTED BUTTON LOGIC


Violin
Piano
Piccolo
Harmonic Flute 2-2/3
Harmonic Flute 4
Vibra Harp
Vibes
G11
G10
G68
G71
G69
G70
G79
G72
G78
G73
G77
G74
G76
G75
IC2E
IC3B
IC4A
IC3D
IC4B
IC3C
IC4C
IC5D
IC4D
IC5C
IC4F
IC5A
IC4E
IC5B
G81
G88
G85
G105
G80
G98
G99
To D. C. Control Pt. J4 See Dwg. 2
To D. C. Control Pt. J36 & R/S Q.C. Pt. H24 See Dwgs. 2 & 8 Resp.
To D. C. Control Pt. J39 & R/S Q.C. Pt. H25 See Dwgs. 2 & 8 Resp.
To D. C. Control Pt. J6 See Dwg. 2
To D. C. Control Pt. J42 & 2-2/3 Switcher Q27 See Dwgs. 2 & 5 Resp.
To D. C. Control Pt. J8 See Dwg. 2
To D. C. Control Pt. J37 See Dwg. 2
+15V
22Ω 1/2W
G16
LAMP DRIVERS (Lamps part of switches)
G38
Q6
G93
Q7
G91
Q8
G102
Q9
G106
Q10
G95
Q11
G97
Q12
.27
100K
1K
10K
.022
Clavecin
Piano
Oboe
Sax
Clarinet
Trumpet
Trombone
G21
G36
G41
G40
G82
G39
G84
G90
G87
G89
G103
G96
G101
G100
IC7D
IC6A
IC7E
IC8B
IC7F
IC8A
IC9A
IC8D
IC9B
IC8C
IC9F
IC10A
IC9E
IC10B
G54
G114
G113
G118
G117
G124
G123
To Solo Keying Pt. N20 See Dwg. 16
To Solo Keying Pt. N18 See Dwg. 16
To Solo Keying Pt. N16 See Dwg. 16
To Solo Keying Pt. N23 See Dwg. 16
To Solo Keying Pt. N21 See Dwg. 16
To Solo Keying Pt. N12 See Dwg. 16
To Solo Keying Pt. N17 See Dwg. 16
+15V
22Ω 1/2W
G20
LAMP DRIVERS (Lamps part of switches)
G46
Q16
G116
Q17
G115
Q18
G120
Q19
G119
Q20
G122
Q21
G121
Q22
Symphonic Wow
(Part of Orch. Presets)
Solo Keying
Upper
Cello
Viola
Violina
SYMPHONIC STRING PRESET LATCHES
Lower
Viola
Violina
G132
G135
G143
G136
G140
G139
G141
G138
G142
G137
G107
G94
G108
G92
IC11F
IC13A
IC11D
IC12A
IC11B
IC12C
IC11A
IC12D
IC11C
IC12B
IC9D
IC10C
IC9C
IC10D
G60
G45
G59
G52
G130
G129
To Lower Violina Switcher Q36 See Dwg. 6
To S. Wow Drive Pt. J15 See Dwg. 2 & To R/S Q.C. Pt. H5 See Dwg. 8
To Cello Switcher Q24 See Dwg. 6 & To 16' Harmonic Mixer Enable Line Pt. H11 See Dwg. 8
To Upper Viola Switcher Q23 See Dwg. 6
To Upper Violina Switcher Q22 See Dwg. 6
To Lower Viola Switcher Q35 See Dwg. 6
+15V
22Ω 1/2W
G48
G50
To Solo Keying Trigger IC18 Pin 9 See Dwg. 15
G64
G61
Q30
Q24
G51
G47
Q27
G63
G62
Q26
G57
G56
Q25
G125
G131
Q29
G127
G126
Q28
LAMP DRIVERS (Lamps part of switches)

BOARD G
LIGHTED BUTTON LOGIC

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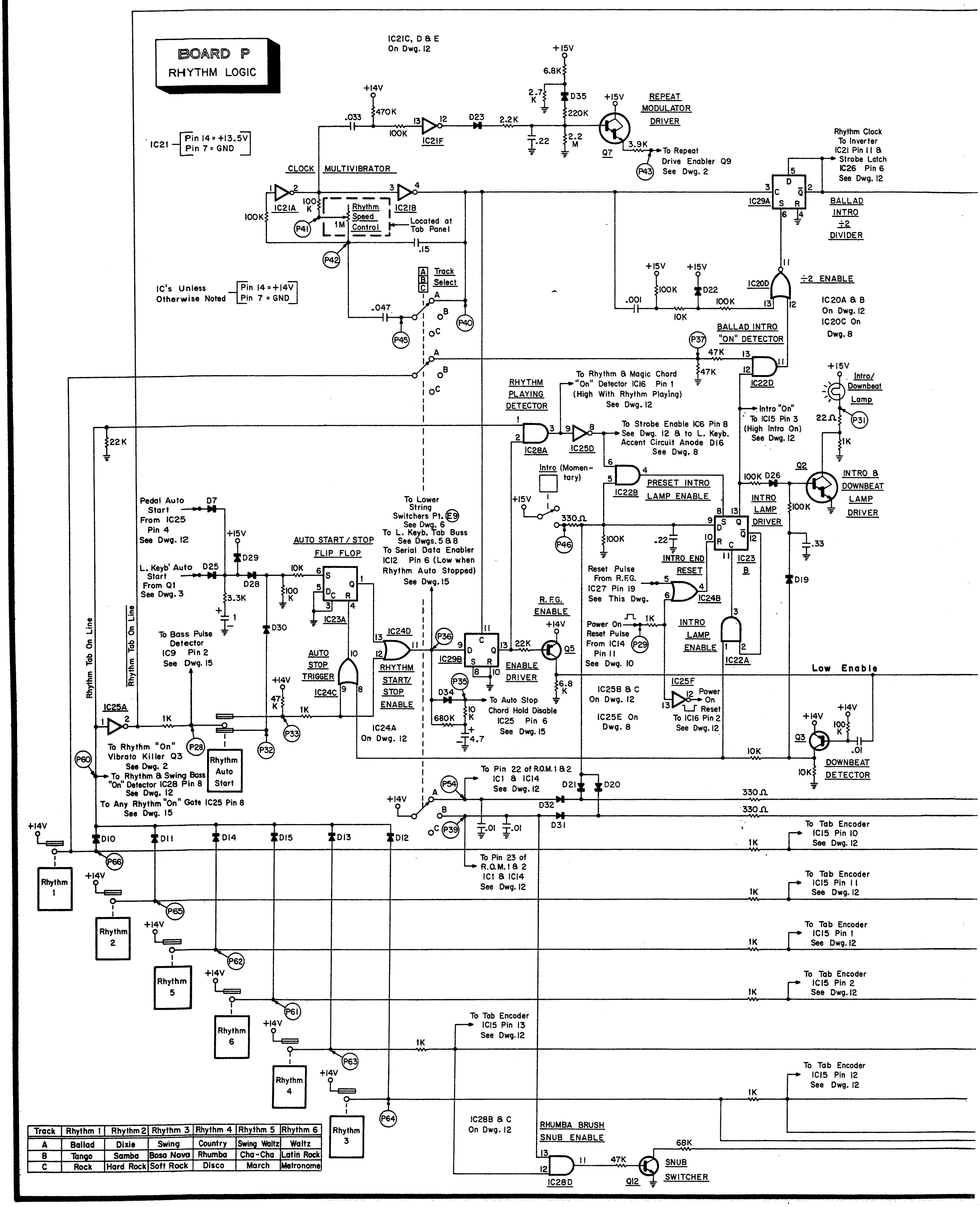
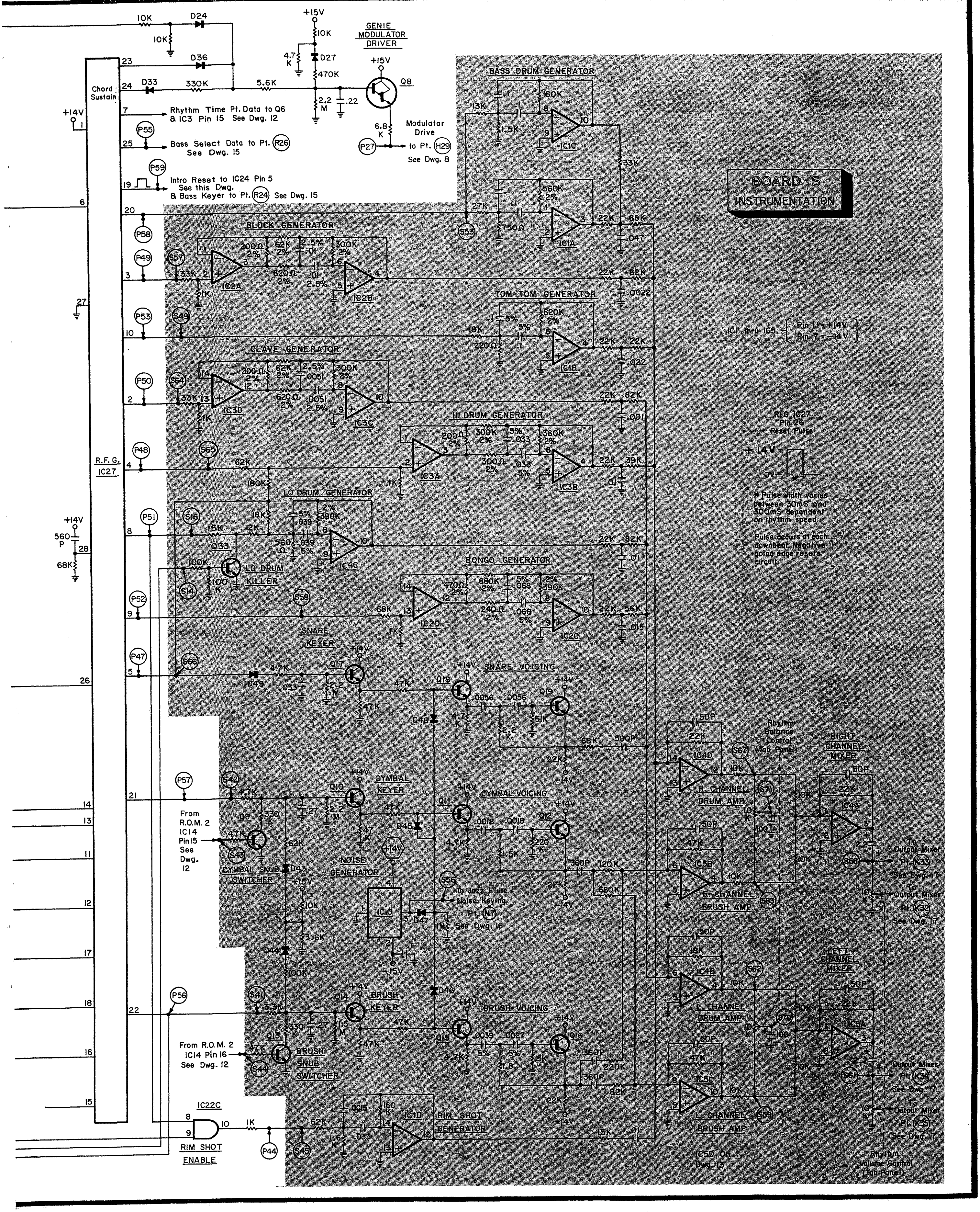
RHYTHM


BOARD P
RHYTHM LOGIC
IC21C, D & E On Dwg. 12
IC21 — Pin 14 = +13.5V, Pin 7 = GND
IC's Unless Otherwise Noted — Pin 14 = +14V, Pin 7 = GND
CLOCK MULTIVIBRATOR
Rhythm Speed Control
Located at Tab Panel
REPEAT MODULATOR DRIVER
To Repeat Drive Enabler Q9 See Dwg. 2
Rhythm Clock To Inverter IC21 Pin 11 & Strobe Latch IC26 Pin 6 See Dwg. 12
BALLAD INTRO ÷2 DIVIDER
÷2 ENABLE
IC20A & B On Dwg. 12
IC20C On Dwg. 8
BALLAD INTRO "ON" DETECTOR
Track Select
Intro/Downbeat Lamp
Intro "On" To IC15 Pin 3 (High Intro On) See Dwg. 12
INTRO & DOWNBEAT LAMP DRIVER
RHYTHM PLAYING DETECTOR
To Rhythm & Magic Chord "On" Detector IC16 Pin 1 (High With Rhythm Playing) See Dwg. 12
To Strobe Enable IC6 Pin 8 See Dwg. 12 & to L. Keyb. Accent Circuit Anode D16 See Dwg. 8
Intro (Momentary)
PRESET INTRO LAMP ENABLE
INTRO LAMP DRIVER
INTRO END RESET
Reset Pulse From R.F.G. IC27 Pin 19 See This Dwg.
Power On Reset Pulse From IC14 Pin 11 See Dwg. 10
INTRO LAMP ENABLE
IC25F Power On Reset To IC16 Pin 2 See Dwg. 12
IC25B & C On Dwg. 12
IC25E On Dwg. 8
Low Enable
DOWNBEAT DETECTOR
Pedal Auto Start From IC25 Pin 4 See Dwg. 12
L. Keyb' Auto Start From Q1 See Dwg. 3
To Bass Pulse Detector IC9 Pin 2 See Dwg. 15
AUTO START / STOP FLIP FLOP
AUTO STOP TRIGGER
To Lower String Switchers Pt. E9 See Dwg. 6
To L. Keyb. Tab Buss See Dwgs. 5 & 8
To Serial Data Enabler IC12 Pin 6 (Low when Rhythm Auto Stopped) See Dwg. 15
RHYTHM START/STOP ENABLE
IC24A On Dwg. 12
R.F.G. ENABLE
ENABLE DRIVER
To Auto Stop Chord Hold Disable IC25 Pin 6 See Dwg. 15
Rhythm Tab On Line
To Rhythm "On" Vibrato Killer Q3 See Dwg. 2
To Rhythm & Swing Bass "On" Detector IC28 Pin 8 See Dwg. 12
To Any Rhythm "On" Gate IC25 Pin 8 See Dwg. 15
Rhythm Auto Start
To Pin 22 of R.O.M. 1 & 2 IC1 & IC14 See Dwg. 12
To Pin 23 of R.O.M. 1 & 2 IC1 & IC14 See Dwg. 12
To Tab Encoder IC15 Pin 10 See Dwg. 12
To Tab Encoder IC15 Pin 11 See Dwg. 12
To Tab Encoder IC15 Pin 1 See Dwg. 12
To Tab Encoder IC15 Pin 2 See Dwg. 12
To Tab Encoder IC15 Pin 13 See Dwg. 12
To Tab Encoder IC15 Pin 12 See Dwg. 12
Rhythm 1
Rhythm 2
Rhythm 5
Rhythm 6
Rhythm 4
Rhythm 3
IC28B & C On Dwg. 12
RHUMBA BRUSH SNUB ENABLE
SNUB SWITCHER

Track	Rhythm 1	Rhythm 2	Rhythm 3	Rhythm 4	Rhythm 5	Rhythm 6
A	Ballad	Dixie	Swing	Country	Swing Waltz	Waltz
B	Tango	Samba	Bosa Nova	Rhumba	Cha-Cha	Latin Rock
C	Rock	Hard Rock	Soft Rock	Disco	March	Metronome

RHYTHM

11



GENIE MODULATOR DRIVER
Modulator Drive
to Pt. (H29) See Dwg. 8
Chord Sustain
Rhythm Time Pt. Data to Q6 & IC3 Pin 15 See Dwg. 12
Bass Select Data to Pt. (R26) See Dwg. 15
Intro Reset to IC24 Pin 5 See this Dwg. & Bass Keyer to Pt. (R24) See Dwg. 15
R.F.G. IC27
BASS DRUM GENERATOR
BLOCK GENERATOR
TOM-TOM GENERATOR
CLAVE GENERATOR
HI DRUM GENERATOR
LO DRUM GENERATOR
LO DRUM KILLER
BONGO GENERATOR
SNARE KEYER
SNARE VOICING
CYMBAL KEYER
CYMBAL VOICING
CYMBAL SNUB SWITCHER
NOISE GENERATOR
To Jazz Flute Noise Keying Pt. (N7) See Dwg. 16
From R.O.M. 2 IC14 Pin 15 See Dwg. 12
BRUSH KEYER
BRUSH VOICING
BRUSH SNUB SWITCHER
From R.O.M. 2 IC14 Pin 16 See Dwg. 12
IC22C
RIM SHOT ENABLE
RIM SHOT GENERATOR
BOARD S INSTRUMENTATION
IC1 thru IC5 – Pin 11 = +14V, Pin 7 = –14V
RFG IC27 Pin 26 Reset Pulse
+14V
0V
* Pulse width varies between 30mS and 300mS dependent on rhythm speed
Pulse occurs at each downbeat. Negative going edge resets circuit.
R. CHANNEL DRUM AMP
R. CHANNEL BRUSH AMP
L. CHANNEL DRUM AMP
L. CHANNEL BRUSH AMP
Rhythm Balance Control (Tab Panel)
RIGHT CHANNEL MIXER
LEFT CHANNEL MIXER
To Output Mixer Pt. (K33) See Dwg. 17
To Output Mixer Pt. (K32) See Dwg. 17
To Output Mixer Pt. (K34) See Dwg. 17
To Output Mixer Pt. (K35) See Dwg. 17
Rhythm Volume Control (Tab Panel)
IC5D On Dwg. 13

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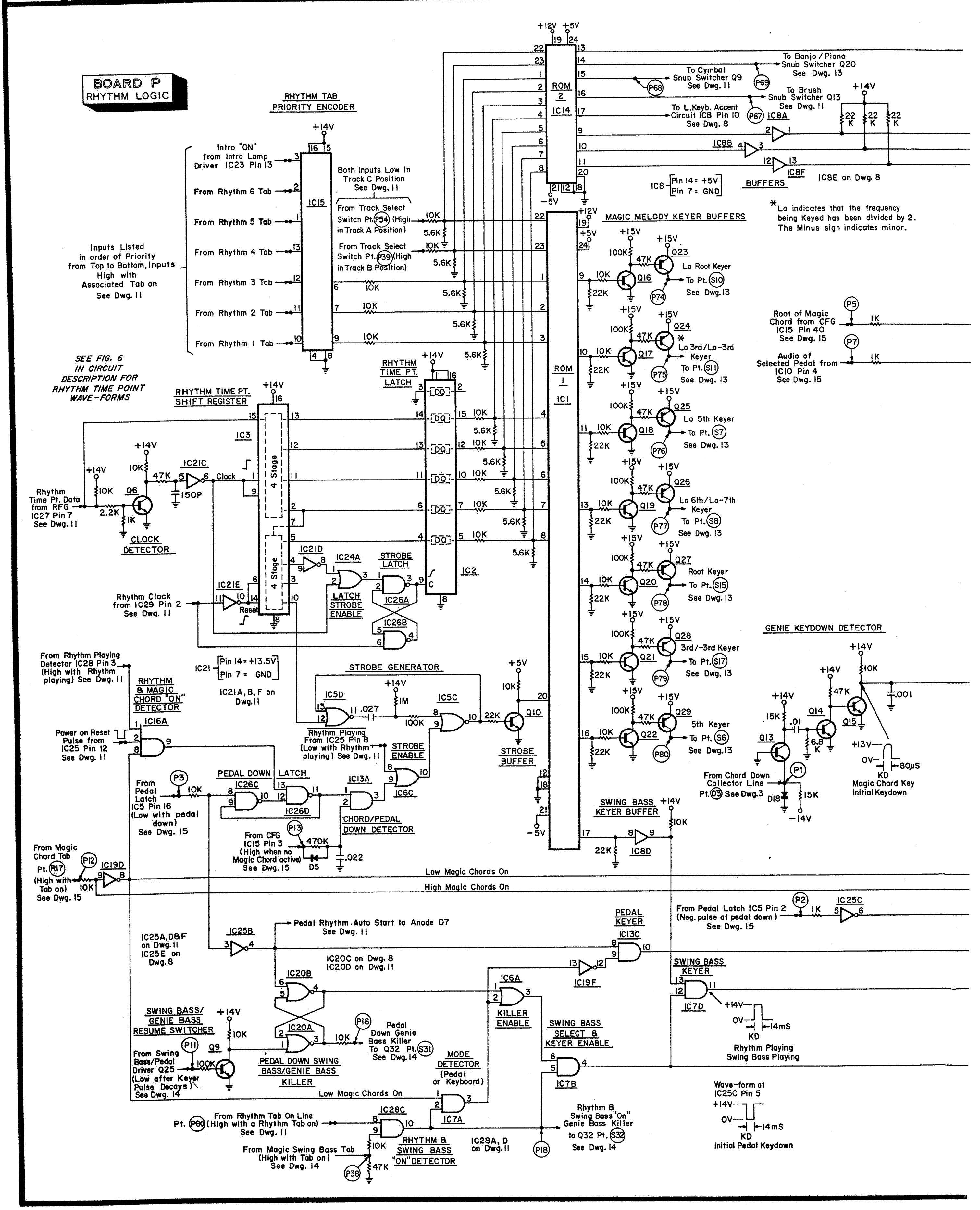
MAGIC MELODY & SWING BASS LOGIC


BOARD P
RHYTHM LOGIC
RHYTHM TAB PRIORITY ENCODER
Intro "ON" from Intro Lamp Driver IC23 Pin 13
From Rhythm 6 Tab
From Rhythm 5 Tab
From Rhythm 4 Tab
From Rhythm 3 Tab
From Rhythm 2 Tab
From Rhythm 1 Tab
Inputs Listed in order of Priority from Top to Bottom, Inputs High with Associated Tab on See Dwg. 11
IC15
Both Inputs Low in Track C Position See Dwg. 11
From Track Select Switch Pt. P54 (High in Track A Position)
From Track Select Switch Pt. P39 (High in Track B Position)
ROM 2
IC14
To Banjo / Piano Snub Switcher Q20 See Dwg. 13
To Cymbal Snub Switcher Q9 See Dwg. 11
To Brush Snub Switcher Q13 See Dwg. 11
To L.Keyb. Accent Circuit IC8 Pin 10 See Dwg. 8
IC8A
IC8B
IC8F
BUFFERS
IC8E on Dwg. 8
IC8 Pin 14 = +5V Pin 7 = GND
MAGIC MELODY KEYER BUFFERS
*Lo indicates that the frequency being Keyed has been divided by 2. The Minus sign indicates minor.
Q23 Lo Root Keyer To Pt. S10 See Dwg. 13
Q16
Q24 * Lo 3rd/Lo-3rd Keyer To Pt. S11 See Dwg. 13
Q17
Q25 Lo 5th Keyer To Pt. S7 See Dwg. 13
Q18
Q26 Lo 6th/Lo-7th Keyer To Pt. S8 See Dwg. 13
Q19
Q27 Root Keyer To Pt. S15 See Dwg. 13
Q20
Q28 3rd/-3rd Keyer To Pt. S17 See Dwg. 13
Q21
Q29 5th Keyer To Pt. S6 See Dwg. 13
Q22
ROM 1
IC1
Root of Magic Chord from CFG IC15 Pin 40 See Dwg. 15
Audio of Selected Pedal from IC10 Pin 4 See Dwg. 15
SEE FIG. 6 IN CIRCUIT DESCRIPTION FOR RHYTHM TIME POINT WAVE-FORMS
RHYTHM TIME PT. SHIFT REGISTER
IC3
4 Stage
RHYTHM TIME PT. LATCH
IC2
Rhythm Time Pt. Data from RFG IC27 Pin 7 See Dwg. 11
Q6
CLOCK DETECTOR
IC21C
Clock
IC21D
IC24A
STROBE LATCH
IC26A
IC26B
LATCH STROBE ENABLE
IC21E
Reset
Rhythm Clock from IC29 Pin 2 See Dwg. 11
IC21 Pin 14 = +13.5V Pin 7 = GND
IC21A, B, F on Dwg. 11
STROBE GENERATOR
IC5D
IC5C
Q10
STROBE BUFFER
Rhythm Playing From IC25 Pin 8 (Low with Rhythm playing) See Dwg. 11
STROBE ENABLE
From Rhythm Playing Detector IC28 Pin 3 (High with Rhythm playing) See Dwg. 11
RHYTHM & MAGIC CHORD "ON" DETECTOR
IC16A
Power on Reset Pulse from IC25 Pin 12 See Dwg. 11
PEDAL DOWN LATCH
IC26C
IC26D
IC13A
IC6C
From Pedal Latch IC5 Pin 16 (Low with pedal down) See Dwg. 15
CHORD/PEDAL DOWN DETECTOR
From CFG IC15 Pin 3 (High when no Magic Chord active) See Dwg. 15
D5
From Magic Chord Tab Pt. R17 (High with Tab on) See Dwg. 15
IC19D
Low Magic Chords On
High Magic Chords On
SWING BASS KEYER BUFFER
IC8D
GENIE KEYDOWN DETECTOR
Q13
Q14
Q15
From Chord Down Collector Line Pt. D3 See Dwg. 3
D18
KD Magic Chord Key Initial Keydown
80μS
From Pedal Latch IC5 Pin 2 (Neg. pulse at pedal down) See Dwg. 15
IC25C
PEDAL KEYER
IC13C
IC19F
SWING BASS KEYER
IC7D
KD Rhythm Playing Swing Bass Playing
14mS
IC25A, D & F on Dwg. 11
IC25E on Dwg. 8
IC25B
Pedal Rhythm Auto Start to Anode D7 See Dwg. 11
IC20C on Dwg. 8
IC20D on Dwg. 11
IC20B
IC20A
IC6A
KILLER ENABLE
SWING BASS/ GENIE BASS RESUME SWITCHER
Q9
From Swing Bass/Pedal Driver Q25 (Low after Keyer Pulse Decays) See Dwg. 14
PEDAL DOWN SWING BASS/GENIE BASS KILLER
Pedal Down Genie Bass Killer To Q32 Pt. S31 See Dwg. 14
MODE DETECTOR (Pedal or Keyboard)
SWING BASS SELECT & KEYER ENABLE
IC7B
Wave-form at IC25C Pin 5
KD Initial Pedal Keydown
From Rhythm Tab On Line Pt. P60 (High with a Rhythm Tab on) See Dwg. 11
IC28C
IC7A
RHYTHM & SWING BASS "ON" DETECTOR
IC28A, D on Dwg. 11
P18
Rhythm & Swing Bass "On" Genie Bass Killer to Q32 Pt. S32 See Dwg. 14
From Magic Swing Bass Tab (High with Tab on) See Dwg. 14
P38

MAGIC MELODY & SWING BASS LOGIC

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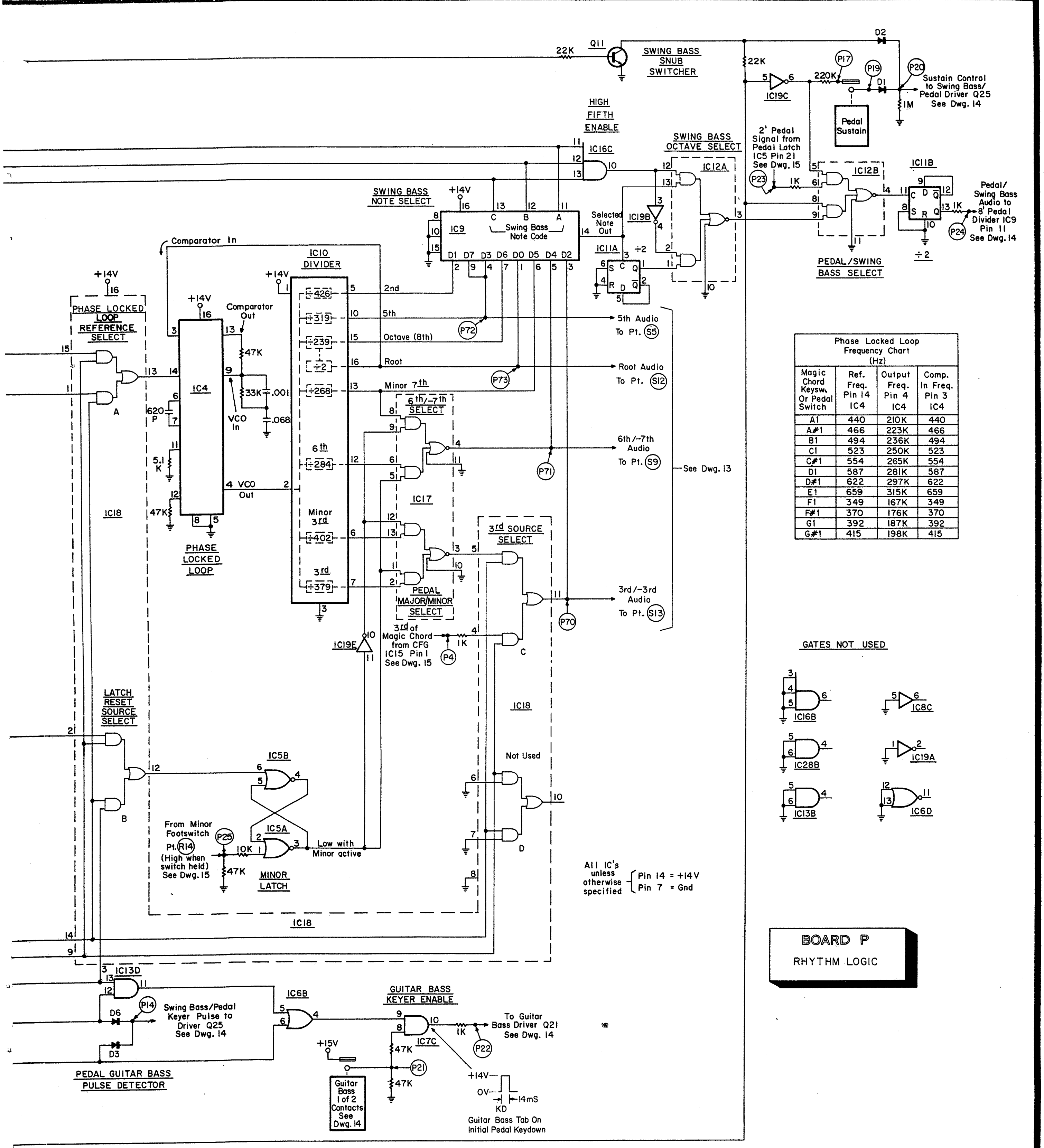
Q11
22K
SWING BASS SNUB SWITCHER
D2
22K
P17
P19
P20
5
6
IC19C
220K
D1
1M
Sustain Control to Swing Bass/Pedal Driver Q25 See Dwg. 14
Pedal Sustain
HIGH FIFTH ENABLE
IC16C
SWING BASS OCTAVE SELECT
IC12A
2' Pedal Signal from Pedal Latch IC5 Pin 21 See Dwg. 15
P23
1K
IC12B
IC11B
Pedal/Swing Bass Audio to 8' Pedal Divider IC9 Pin 11 See Dwg. 14
P24
÷2
PEDAL/SWING BASS SELECT
SWING BASS NOTE SELECT
+14V
IC9
C B A
Swing Bass Note Code
Selected Note Out
IC19B
IC11A
÷2
D1 D7 D3 D6 D0 D5 D4 D2
Comparator In
IC10 DIVIDER
+14V
÷426
÷319
÷239
÷2
÷268
6th
÷284
Minor 3rd
÷402
3rd
÷379
2nd
5th
Octave (8th)
Root
Minor 7th
P72
P73
5th Audio To Pt. S5
Root Audio To Pt. S12
6th/-7th Audio To Pt. S9
P71
See Dwg. 13
6th/-7th SELECT
IC17
PEDAL MAJOR/MINOR SELECT
3rd SOURCE SELECT
3rd/-3rd Audio To Pt. S13
P70
3rd of Magic Chord from CFG IC15 Pin 1 See Dwg. 15
P4
1K
IC19E
C
IC18
Not Used
D
+14V
PHASE LOCKED LOOP REFERENCE SELECT
A
IC18
+14V
Comparator Out
IC4
47K
33K
.001
.068
VCO In
620 P
5.1 K
47K
4 VCO Out
PHASE LOCKED LOOP
LATCH RESET SOURCE SELECT
B
IC5B
IC5A
From Minor Footswitch Pt. R14 (High when switch held) See Dwg. 15
P25
10K
47K
MINOR LATCH
Low with Minor active
IC18
IC13D
IC6B
D6
D3
P14
Swing Bass/Pedal Keyer Pulse to Driver Q25 See Dwg. 14
PEDAL GUITAR BASS PULSE DETECTOR
GUITAR BASS KEYER ENABLE
IC7C
1K
To Guitar Bass Driver Q21 See Dwg. 14
P22
+15V
47K
P21
47K
Guitar Bass 1 of 2 Contacts See Dwg. 14
+14V
0V
14mS
KD
Guitar Bass Tab On Initial Pedal Keydown
GATES NOT USED
IC16B
IC8C
IC28B
IC19A
IC13B
IC6D

Phase Locked Loop Frequency Chart (Hz)

Magic Chord Keysw. Or Pedal Switch	Ref. Freq. Pin 14 IC4	Output Freq. Pin 4 IC4	Comp. In Freq. Pin 3 IC4
A1	440	210K	440
A#1	466	223K	466
B1	494	236K	494
C1	523	250K	523
C#1	554	265K	554
D1	587	281K	587
D#1	622	297K	622
E1	659	315K	659
F1	349	167K	349
F#1	370	176K	370
G1	392	187K	392
G#1	415	198K	415

All IC's unless otherwise specified
Pin 14 = +14V
Pin 7 = Gnd

BOARD P
RHYTHM LOGIC

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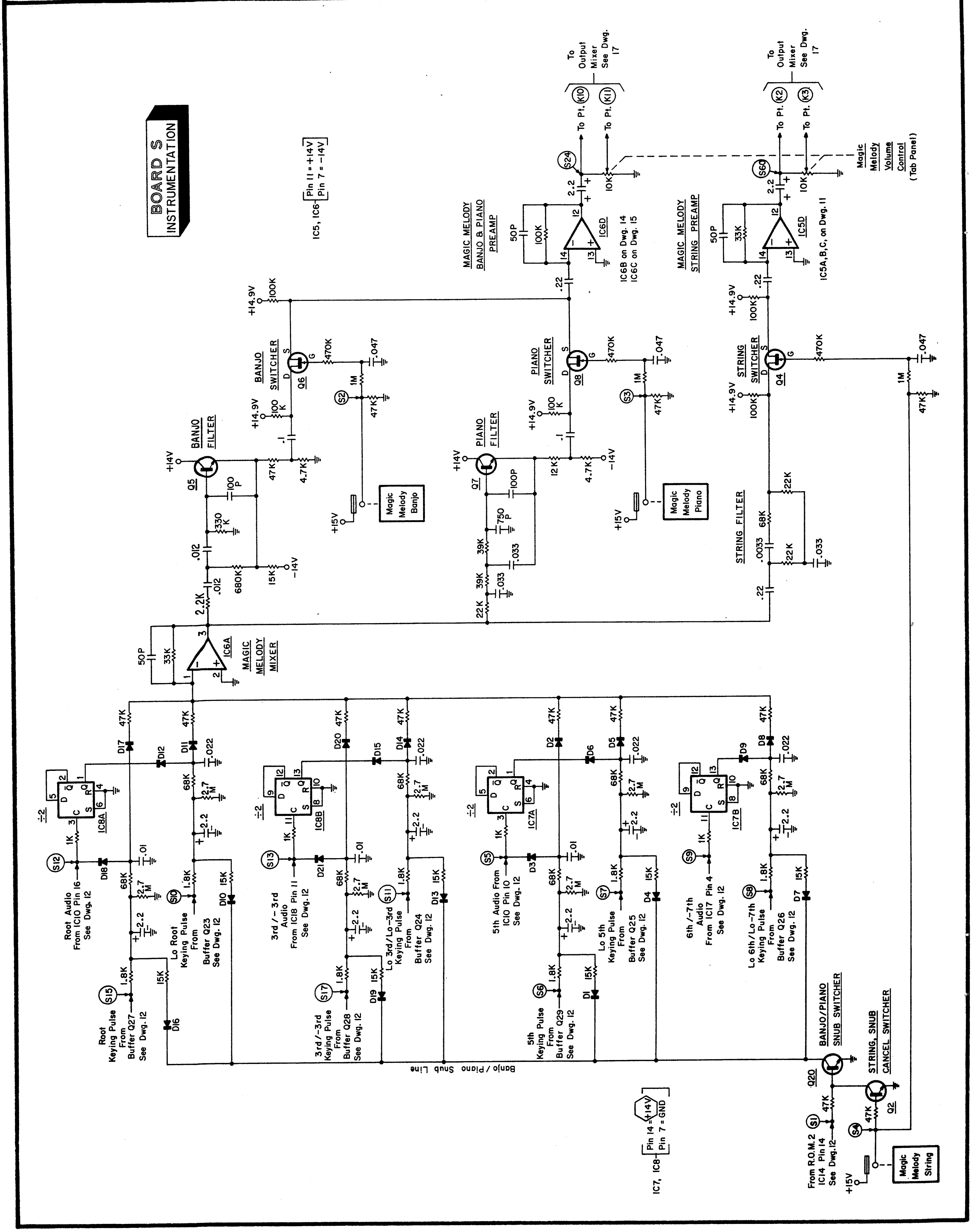
MAGIC MELODY KEYING & FILTERING


BOARD S
INSTRUMENTATION
IC5, IC6 [Pin 11 = +14V, Pin 7 = −14V]
To Output Mixer — See Dwg. 17
To Pt. (K10)
To Pt. (K11)
To Pt. (K2)
To Pt. (K3)
Magic Melody Volume Control (Tab Panel)
MAGIC MELODY BANJO & PIANO PREAMP
IC6D
IC6B on Dwg. 14
IC6C on Dwg. 15
MAGIC MELODY STRING PREAMP
IC5D
IC5A, B, C, on Dwg. 11
BANJO SWITCHER
Q6
PIANO SWITCHER
Q8
STRING SWITCHER
Q4
BANJO FILTER
Q5
PIANO FILTER
Q7
STRING FILTER
Magic Melody Banjo
Magic Melody Piano
Magic Melody String
IC6A
MAGIC MELODY MIXER
IC8A
IC8B
IC7A
IC7B
÷2
Root Audio From IC10 Pin 16 See Dwg. 12
Lo Root Keying Pulse From Buffer Q23 See Dwg. 12
Root Keying Pulse From Buffer Q27 See Dwg. 12
3rd/−3rd Audio From IC18 Pin 11 See Dwg. 12
Lo 3rd/Lo−3rd Keying Pulse From Buffer Q24 See Dwg. 12
3rd/−3rd Keying Pulse From Buffer Q28 See Dwg. 12
5th Audio From IC10 Pin 10 See Dwg. 12
Lo 5th Keying Pulse From Buffer Q25 See Dwg. 12
5th Keying Pulse From Buffer Q29 See Dwg. 12
6th/−7th Audio From IC17 Pin 4 See Dwg. 12
Lo 6th/Lo−7th Keying Pulse From Buffer Q26 See Dwg. 12
Banjo/Piano Snub Line
BANJO/PIANO SNUB SWITCHER
Q20
STRING, SNUB CANCEL SWITCHER
Q2
From R.O.M.2 IC14 Pin 14 See Dwg. 12
IC7, IC8 [Pin 14 = +14V, Pin 7 = GND]
+14.9V
+14V
−14V
+15V
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S15
S17
S24
S60

BASS FILTERING

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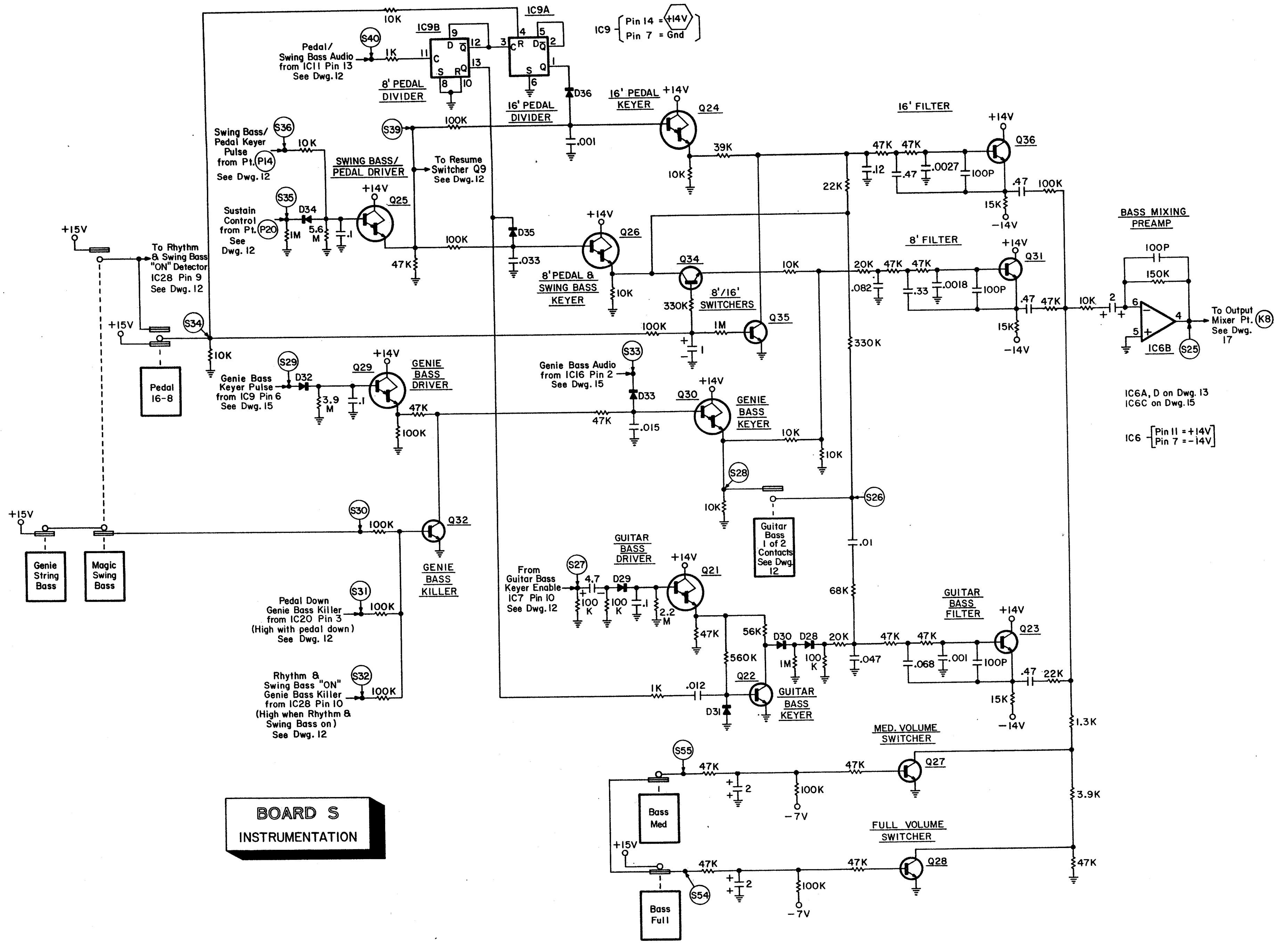
IC9A
IC9B
IC9 { Pin 14 = +14V, Pin 7 = Gnd }
10K
Pedal/ Swing Bass Audio from IC11 Pin 13 See Dwg. 12
S40
1K
8' PEDAL DIVIDER
16' PEDAL DIVIDER
D36
.001
16' PEDAL KEYER
+14V
Q24
16' FILTER
Q36
Swing Bass/ Pedal Keyer Pulse from Pt. P14 See Dwg. 12
S36
S39
100K
SWING BASS/ PEDAL DRIVER
To Resume Switcher Q9 See Dwg. 12
Q25
Sustain Control from Pt. P20 See Dwg. 12
S35
D34
1M
5.6 M
.1
47K
D35
.033
Q26
8' PEDAL & SWING BASS KEYER
39K
10K
47K
.12
.47
.0027
100P
22K
15K
-14V
BASS MIXING PREAMP
150K
8' FILTER
Q31
Q34
8'/16' SWITCHERS
330K
Q35
1M
20K
.082
.33
.0018
IC6B
S25
To Output Mixer Pt. K8 See Dwg. 17
+15V
To Rhythm & Swing Bass "ON" Detector IC28 Pin 9 See Dwg. 12
S34
Pedal 16-8
Genie Bass Keyer Pulse from IC9 Pin 6 See Dwg. 15
S29
D32
3.9 M
Q29
GENIE BASS DRIVER
Genie Bass Audio from IC16 Pin 2 See Dwg. 15
S33
D33
.015
Q30
GENIE BASS KEYER
IC6A, D on Dwg. 13
IC6C on Dwg. 15
IC6 [Pin 11 = +14V, Pin 7 = -14V]
S28
S26
Guitar Bass 1 of 2 Contacts See Dwg. 12
.01
S30
Q32
GENIE BASS KILLER
Genie String Bass
Magic Swing Bass
Pedal Down Genie Bass Killer from IC20 Pin 3 (High with pedal down) See Dwg. 12
S31
Rhythm & Swing Bass "ON" Genie Bass Killer from IC28 Pin 10 (High when Rhythm & Swing Bass on) See Dwg. 12
S32
GUITAR BASS DRIVER
From Guitar Bass Keyer Enable IC7 Pin 10 See Dwg. 12
S27
4.7
D29
2.2 M
Q21
68K
56K
560K
D30
D28
.047
GUITAR BASS FILTER
Q23
.068
.001
1K
.012
Q22
D31
GUITAR BASS KEYER
1.3K
MED. VOLUME SWITCHER
Q27
S55
2
-7V
Bass Med
3.9K
FULL VOLUME SWITCHER
Q28
Bass Full
S54
BOARD S
INSTRUMENTATION

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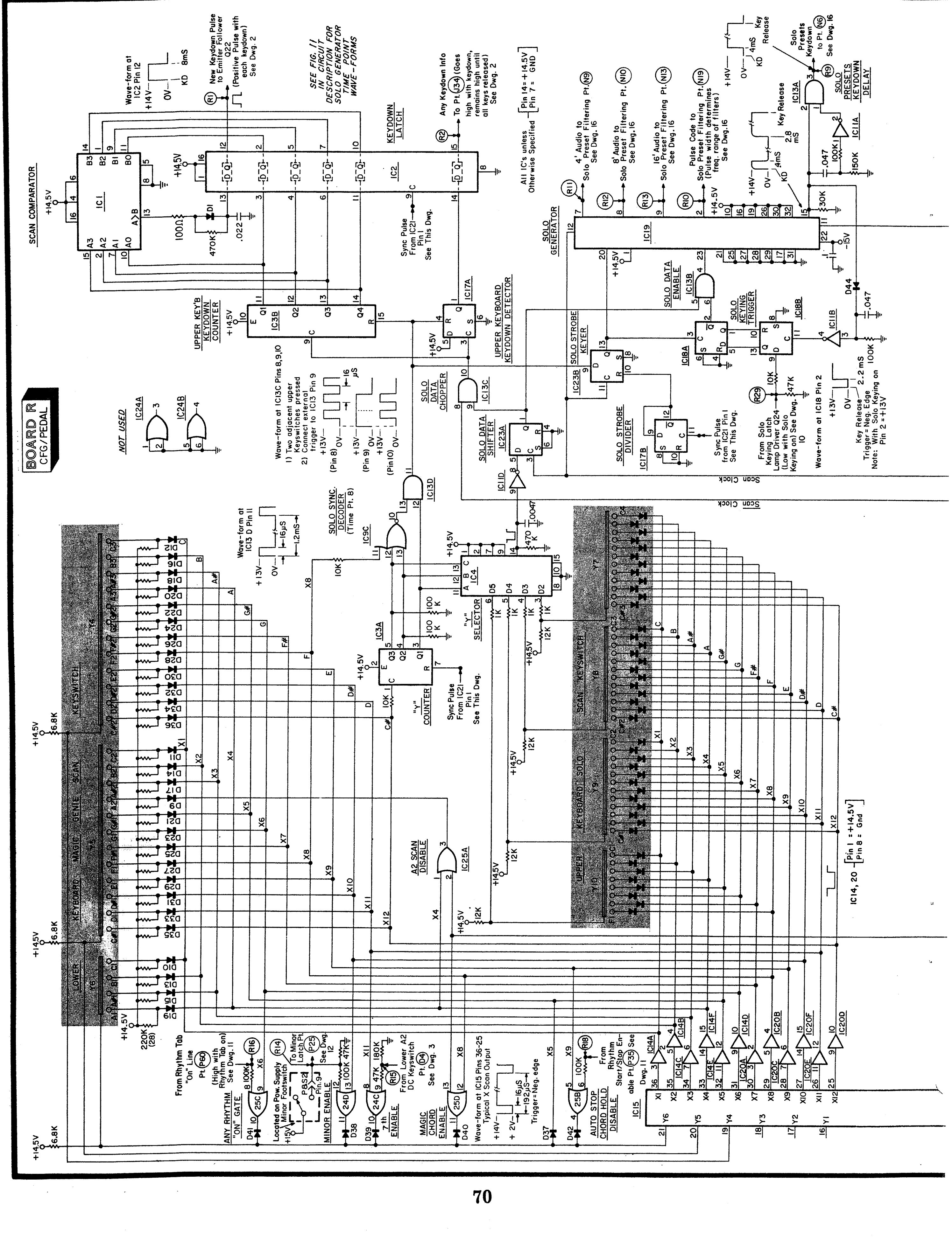
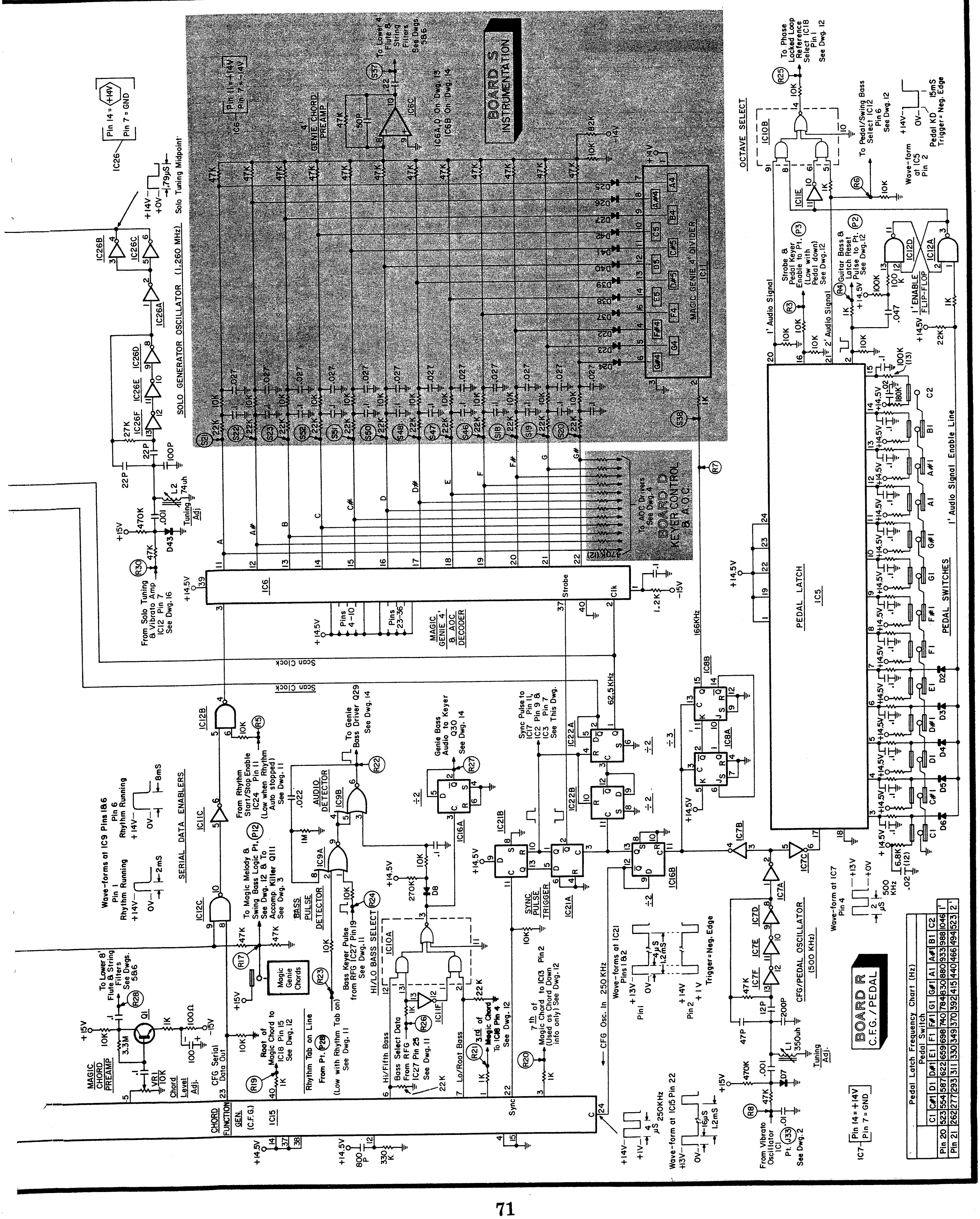
CFG, SOLO GENERATOR & PEDAL LATCH


BOARD R CFG/PEDAL
SCAN COMPARATOR
IC1
KEYDOWN LATCH
IC2
UPPER KEY'B KEYDOWN COUNTER
IC3B
UPPER KEYBOARD KEYDOWN DETECTOR
IC17A
SOLO GENERATOR
IC19
SOLO DATA ENABLE
IC13B
SOLO KEYING TRIGGER
IC18B
SOLO STROBE KEYER
IC23B
SOLO STROBE DIVIDER
IC17B
SOLO DATA CHOPPER
IC13C
SOLO DATA SHIFTER
IC23A
SOLO SYNC. DECODER (Time Pt. 8)
IC9C
IC13D
IC11D
IC4
"Y" SELECTOR
"Y" COUNTER
IC3A
A2 SCAN DISABLE
IC25A
SOLO PRESETS KEYDOWN DELAY
IC13A
IC11A
IC11B
IC18A
NOT USED
IC24A
IC24B
New Keydown Pulse to Emitter Follower Q22 (Positive Pulse with each keydown) See Dwg. 2
Wave-form at IC2 Pin 12
SEE FIG. 11 IN CIRCUIT DESCRIPTION FOR SOLO GENERATOR TIME POINT WAVE-FORMS
Any Keydown Info To Pt. J34 (Goes high with keydown, remains high until all keys released) See Dwg. 2
Pin 14 = +14.5V
Pin 7 = GND
All IC's unless Otherwise Specified
4' Audio to Solo Preset Filtering Pt. N9 See Dwg. 16
8' Audio to Solo Preset Filtering Pt. N10 See Dwg. 16
16' Audio to Solo Preset Filtering Pt. N13 See Dwg. 16
Pulse Code to Solo Preset Filtering Pt. N19 (Pulse width determines freq. range of filters) See Dwg. 16
Solo Presets Keydown to Pt. N6 See Dwg. 16
Key Release
Sync Pulse From IC21 Pin 1 See This Dwg.
Wave-form at IC13C Pins 8,9,10
1) Two adjacent upper Keyswitches pressed
2) Connect external trigger to IC13 Pin 9
Wave-form at IC13 D Pin 11
From Solo Keying Latch Lamp Driver Q24 (Low with Solo Keying on) See Dwg. 10
Wave-form at IC18 Pin 2
Key Release Trigger = Neg. Edge
Note: With Solo Keying on Pin 2 = +13V
Scan Clock
UPPER KEYBOARD SOLO SCAN KEYSWITCH
LOWER KEYBOARD MAGIC GENIE SCAN KEYSWITCH
Pin 1 = +14.5V
Pin 8 = Gnd
IC14, 20
IC15
ANY RHYTHM "ON" GATE
From Rhythm Tab "On" Line Pt. P60 (High with Rhythm Tab on) See Dwg. 11
Located on Pow. Supply Minor Footswitch
To Minor Latch Pt. P25 See Dwg. 12
MINOR ENABLE
7 th ENABLE
From Lower A2 DC Keyswitch Pt. D4 See Dwg. 3
MAGIC CHORD ENABLE
Wave-form at IC15 Pins 36-25 Typical X Scan Output
Trigger = Neg. edge
AUTO STOP CHORD HOLD DISABLE
From Rhythm Start/Stop Enable Pt. P35 See Dwg. 11
+14.5V
6.8K
220K (28)

CFG, SOLO GENERATOR & PEDAL LATCH


BOARD S INSTRUMENTATION
BOARD D KEYER CONTROL & A.O.C.
BOARD R C.F.G./PEDAL
SOLO GENERATOR OSCILLATOR (1.260 MHz)
Solo Tuning Midpoint
Tuning Adj.
From Solo Tuning & Vibrato Amp IC12 Pin 7 See Dwg.16
IC26 Pin 14 = +14V Pin 7 = GND
IC6 Pin 11 = +14V Pin 7 = -14V
4' GENIE CHORD PREAMP
To Lower 4' Flute & String Filters See Dwgs. 5&6
IC6A,D On Dwg.13 IC6B On Dwg.14
MAGIC GENIE 4' DIVIDER IC1
To AOC Drivers See Dwg.4
MAGIC GENIE 4' & AOC DECODER
IC6
Strobe
Clk
Scan Clock
62.5KHz
166KHz
SERIAL DATA ENABLERS
Wave-forms at IC9 Pins 1&6
Pin 1 Rhythm Running
Pin 6 Rhythm Running
From Rhythm Start/Stop Enable IC24 Pin 11 (Low when Rhythm Auto stopped) See Dwg. 11
To Magic Melody & Swing Bass Logic Pt. (P12) See Dwg. 12 & To Accomp. Killer Q111 See Dwg. 3
To Genie Bass Driver Q29 See Dwg. 14
Genie Bass Audio to Keyer Q30 See Dwg. 14
AUDIO DETECTOR
BASS PULSE DETECTOR
Bass Keyer Pulse from RFG IC27 Pin 19 See Dwg. 11
HI/LO BASS SELECT
Hi/Fifth Bass
Bass Select Data From RFG IC27 Pin 25 See Dwg. 11
Lo/Root Bass
3rd of Magic Chord To IC18 Pin 4 See Dwg. 12
7th of Magic Chord to IC13 Pin 2 (Used as Chord Down info only) See Dwg. 12
Sync Pulse to IC17 Pin 11, IC3 Pin 9 & Pin 7 See This Dwg.
SYNC PULSE TRIGGER
MAGIC CHORD PREAMP
To Lower 8' Flute & String Filters See Dwgs. 5&6
Magic Genie Chords
Chord Level Adj.
Root of Magic Chord to IC18 Pin 15 See Dwg. 12
Rhythm Tab on Line From Pt. (P28) (Low with Rhythm Tab on) See Dwg. 11
CFG Serial Data Out
CHORD FUNCTION GEN. (C.F.G.) IC15
CFG Osc. In 250 KHz
Wave-forms at IC21 Pins 1&2
Trigger = Neg. Edge
Wave-form at IC15 Pin 22
250KHz
From Vibrato Oscillator IC1 Pt. (J33) See Dwg.2
CFG/PEDAL OSCILLATOR (500 KHz)
Tuning Adj.
IC7 Pin 14 = +14V Pin 7 = GND
Wave-form at IC7 Pin 4
500 KHz
PEDAL LATCH IC5
PEDAL SWITCHES
1' Audio Signal Enable Line
1' Audio Signal
2' Audio Signal
1' ENABLE FLIP-FLOP
Guitar Bass & Latch Reset Pulse to Pt. (P2) See Dwg. 12
Strobe & Pedal Keyer Enable to Pt. (P3) (Low with Pedal down) See Dwg. 12
OCTAVE SELECT
To Phase Locked Loop Reference Select IC18 Pin 1 See Dwg. 12
To Pedal/Swing Bass Select IC12 Pin 6 See Dwg. 12
Wave-form at IC5 Pin 2
Pedal KD Trigger = Neg. Edge

Pedal Latch Frequency Chart (Hz)

	Pedal Switch													
	C1	C#1	D1	D#1	E1	F1	F#1	G1	G#1	A1	A#1	B1	C2	
Pin 20	523	554	587	622	659	698	740	784	830	880	933	988	1046	1'
Pin 21	262	277	293	311	330	349	370	392	415	440	466	494	523	2'

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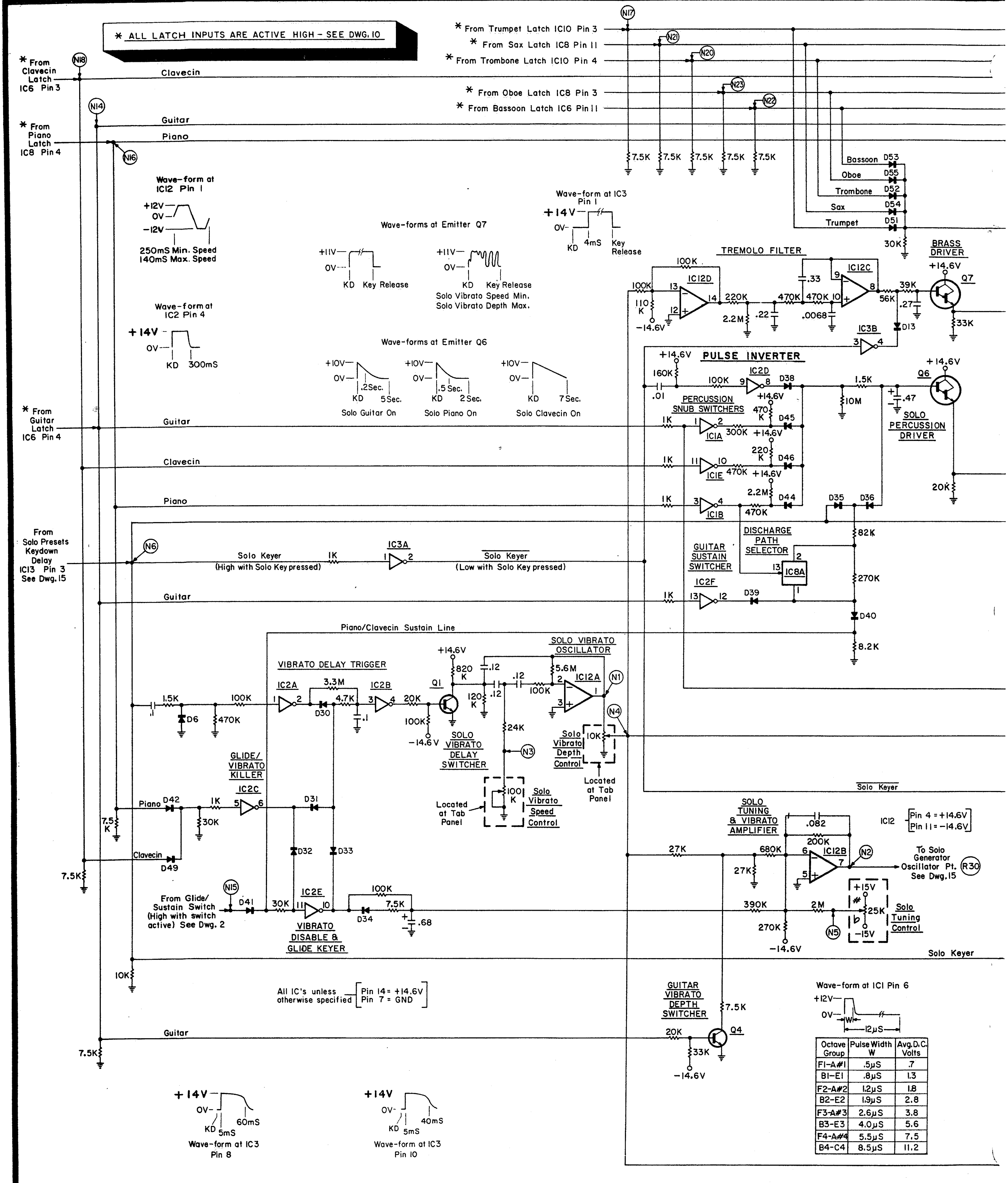
SOLO KEYERS & FILTERS


* ALL LATCH INPUTS ARE ACTIVE HIGH - SEE DWG. 10
* From Trumpet Latch IC10 Pin 3
* From Sax Latch IC8 Pin 11
* From Trombone Latch IC10 Pin 4
* From Oboe Latch IC8 Pin 3
* From Bassoon Latch IC6 Pin 11
N17
N21
N20
N23
N22
* From Clavecin Latch IC6 Pin 3
N18
Clavecin
N14
Guitar
* From Piano Latch IC8 Pin 4
Piano
N16
7.5K
Bassoon D53
Oboe D55
Trombone D52
Sax D54
Trumpet D51
30K
BRASS DRIVER
+14.6V
Q7
Wave-form at IC12 Pin 1
+12V
0V
-12V
250mS Min. Speed
140mS Max. Speed
Wave-forms at Emitter Q7
+11V
0V
KD Key Release
Solo Vibrato Speed Min.
Solo Vibrato Depth Max.
Wave-form at IC3 Pin 1
+14V
4mS
Key Release
TREMOLO FILTER
100K
IC12D
IC12C
110K
-14.6V
220K
2.2M
.22
470K
.0068
.33
39K
56K
.27
D13
33K
IC3B
Wave-form at IC2 Pin 4
+14V
KD 300mS
Wave-forms at Emitter Q6
+10V
.2Sec.
KD 5Sec.
.5Sec.
KD 2Sec.
KD 7Sec.
Solo Guitar On
Solo Piano On
Solo Clavecin On
PULSE INVERTER
+14.6V
160K
.01
IC2D
D38
1.5K
10M
.47
Q6
PERCUSSION SNUB SWITCHERS
1K
IC1A
300K
D45
220K
IC1E
D46
2.2M
IC1B
D44
D35
D36
SOLO PERCUSSION DRIVER
20K
* From Guitar Latch IC6 Pin 4
Guitar
Clavecin
Piano
From Solo Presets Keydown Delay IC13 Pin 3 See Dwg. 15
N6
Solo Keyer (High with Solo Key pressed)
IC3A
Solo Keyer (Low with Solo Key pressed)
DISCHARGE PATH SELECTOR
GUITAR SUSTAIN SWITCHER
IC8A
IC2F
D39
82K
270K
D40
8.2K
Piano/Clavecin Sustain Line
SOLO VIBRATO OSCILLATOR
VIBRATO DELAY TRIGGER
IC2A
3.3M
IC2B
4.7K
D30
Q1
820K
.12
120K
IC12A
5.6M
N1
1.5K
100K
D6
470K
-14.6V
SOLO VIBRATO DELAY SWITCHER
24K
N3
N4
Solo Vibrato Depth Control
10K
Located at Tab Panel
100K
Solo Vibrato Speed Control
GLIDE/ VIBRATO KILLER
IC2C
Piano D42
30K
D31
D32
D33
Clavecin
D49
7.5K
From Glide/ Sustain Switch (High with switch active) See Dwg. 2
N15
D41
30K
IC2E
VIBRATO DISABLE & GLIDE KEYER
D34
.68
10K
Solo Keyer
SOLO TUNING & VIBRATO AMPLIFIER
.082
200K
27K
680K
IC12B
N2
IC12 [Pin 4 = +14.6V / Pin 11 = -14.6V]
To Solo Generator Oscillator Pt. R30 See Dwg. 15
390K
270K
2M
N5
+15V
-15V
25K
Solo Tuning Control
All IC's unless otherwise specified [Pin 14 = +14.6V / Pin 7 = GND]
GUITAR VIBRATO DEPTH SWITCHER
7.5K
20K
Q4
33K
Guitar
Wave-form at IC1 Pin 6
+12V
0V
W
12μS
+14V
0V
KD 5mS
60mS
Wave-form at IC3 Pin 8
40mS
Wave-form at IC3 Pin 10

Octave Group	Pulse Width W	Avg. D.C. Volts
F1-A#1	.5μS	.7
B1-E1	.8μS	1.3
F2-A#2	1.2μS	1.8
B2-E2	1.9μS	2.8
F3-A#3	2.6μS	3.8
B3-E3	4.0μS	5.6
F4-A#4	5.5μS	7.5
B4-C4	8.5μS	11.2

SOLO KEYERS & FILTERS

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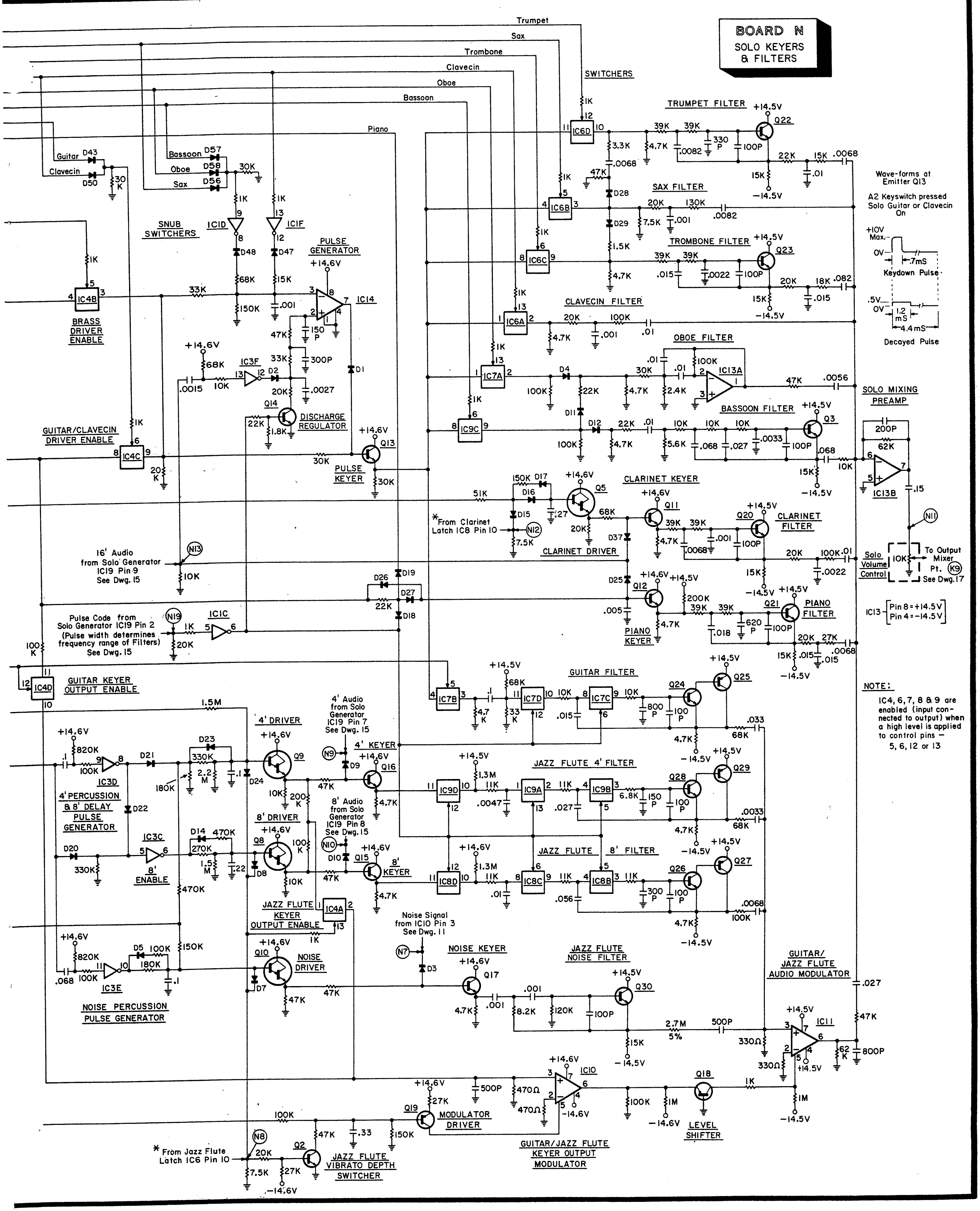
BOARD N
SOLO KEYERS & FILTERS
Trumpet
Sax
Trombone
Clavecin
Oboe
Bassoon
Piano
SWITCHERS
TRUMPET FILTER +14.5V
Q22
IC6D
SAX FILTER
IC6B
TROMBONE FILTER +14.5V
Q23
IC6C
CLAVECIN FILTER
IC6A
OBOE FILTER
IC13A
IC7A
BASSOON FILTER +14.5V
Q3
IC9C
SOLO MIXING PREAMP
IC13B
Wave-forms at Emitter Q13
A2 Keyswitch pressed Solo Guitar or Clavecin On
+10V Max.
0V
.7mS
Keydown Pulse
.5V
1.2 mS
4.4mS
Decayed Pulse
Guitar D43
Clavecin D50
Bassoon D57
Oboe D58
Sax D56
SNUB SWITCHERS
IC1D
IC1F
PULSE GENERATOR +14.6V
IC14
IC4B
BRASS DRIVER ENABLE
IC3F
Q14
DISCHARGE REGULATOR
GUITAR/CLAVECIN DRIVER ENABLE
IC4C
PULSE KEYER
Q13
CLARINET KEYER
Q5
Q11
Q20
CLARINET FILTER
*From Clarinet Latch IC8 Pin 10
N12
CLARINET DRIVER
N11
Solo Volume Control
To Output Mixer Pt. K9 See Dwg. 17
16' Audio from Solo Generator IC19 Pin 9 See Dwg. 15
N13
Q12
Q21
PIANO FILTER
PIANO KEYER
IC13 Pin 8 = +14.5V Pin 4 = -14.5V
Pulse Code from Solo Generator IC19 Pin 2 (Pulse width determines frequency range of Filters) See Dwg. 15
N19
IC1C
GUITAR KEYER OUTPUT ENABLE
IC4D
GUITAR FILTER
IC7B
IC7D
IC7C
Q24
Q25
4' DRIVER
4' Audio from Solo Generator IC19 Pin 7 See Dwg. 15
N9
4' KEYER
Q9
Q16
IC3D
4' PERCUSSION & 8' DELAY PULSE GENERATOR
JAZZ FLUTE 4' FILTER
IC9D
IC9A
IC9B
Q28
Q29
8' DRIVER
8' Audio from Solo Generator IC19 Pin 8 See Dwg. 15
N10
Q8
Q15
8' KEYER
IC3C
8' ENABLE
JAZZ FLUTE 8' FILTER
IC8D
IC8C
IC8B
Q26
Q27
JAZZ FLUTE KEYER OUTPUT ENABLE
IC4A
Noise Signal from IC10 Pin 3 See Dwg. 11
N7
NOISE KEYER
Q17
JAZZ FLUTE NOISE FILTER
Q30
GUITAR/JAZZ FLUTE AUDIO MODULATOR
IC11
Q10
NOISE DRIVER
IC3E
NOISE PERCUSSION PULSE GENERATOR
IC10
Q18
LEVEL SHIFTER
Q19
MODULATOR DRIVER
GUITAR/JAZZ FLUTE KEYER OUTPUT MODULATOR
N8
* From Jazz Flute Latch IC6 Pin 10
Q2
JAZZ FLUTE VIBRATO DEPTH SWITCHER

NOTE:
IC4, 6, 7, 8 & 9 are enabled (input connected to output) when a high level is applied to control pins — 5, 6, 12 or 13

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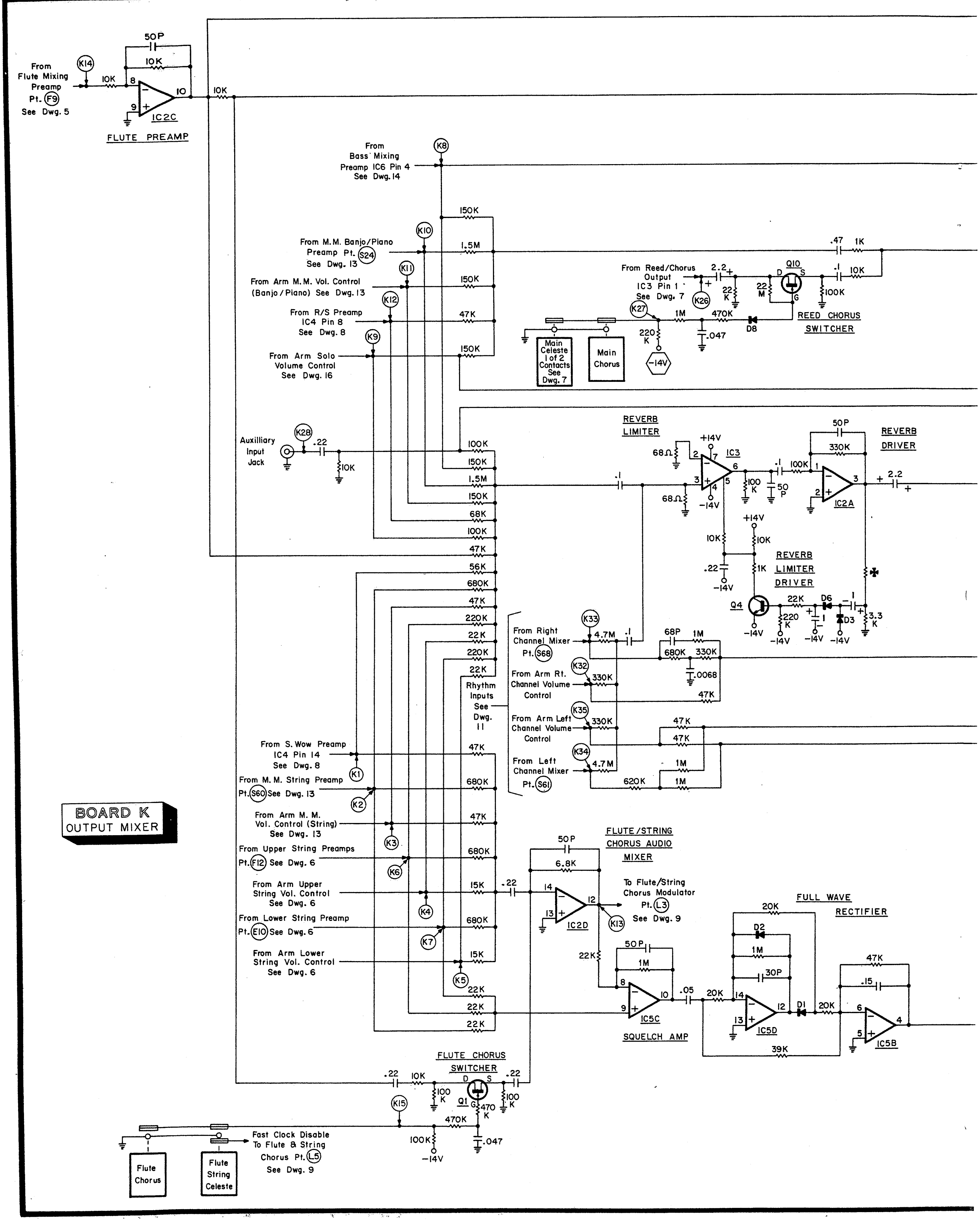
OUTPUT MIXER


From Flute Mixing Preamp Pt. F9 See Dwg. 5
K14
10K
50P
10K
IC2C
FLUTE PREAMP
From Bass Mixing Preamp IC6 Pin 4 See Dwg. 14
K8
From M.M. Banjo/Piano Preamp Pt. S24 See Dwg. 13
K10
From Arm M.M. Vol. Control (Banjo/Piano) See Dwg. 13
K11
From R/S Preamp IC4 Pin 8 See Dwg. 8
K12
From Arm Solo Volume Control See Dwg. 16
K9
From Reed/Chorus Output IC3 Pin 1 See Dwg. 7
K26
K27
Q10
REED CHORUS SWITCHER
Main Celeste 1 of 2 Contacts See Dwg. 7
Main Chorus
-14V
D8
Auxilliary Input Jack
K28
REVERB LIMITER
IC3
+14V
REVERB DRIVER
IC2A
REVERB LIMITER DRIVER
Q4
D6
D3
From Right Channel Mixer Pt. S68
K33
From Arm Rt. Channel Volume Control
K32
From Arm Left Channel Volume Control
K35
From Left Channel Mixer Pt. S61
K34
Rhythm Inputs See Dwg. 11
From S. Wow Preamp IC4 Pin 14 See Dwg. 8
K1
From M. M. String Preamp Pt. S60 See Dwg. 13
K2
From Arm M. M. Vol. Control (String) See Dwg. 13
K3
From Upper String Preamps Pt. F12 See Dwg. 6
K6
From Arm Upper String Vol. Control See Dwg. 6
K4
From Lower String Preamp Pt. E10 See Dwg. 6
K7
From Arm Lower String Vol. Control See Dwg. 6
K5
BOARD K OUTPUT MIXER
FLUTE/STRING CHORUS AUDIO MIXER
IC2D
To Flute/String Chorus Modulator Pt. L3 See Dwg. 9
K13
SQUELCH AMP
IC5C
FULL WAVE RECTIFIER
IC5D
D1
D2
IC5B
FLUTE CHORUS SWITCHER
Q1
K15
Fast Clock Disable To Flute & String Chorus Pt. L5 See Dwg. 9
Flute Chorus
Flute String Celeste

OUTPUT MIXER

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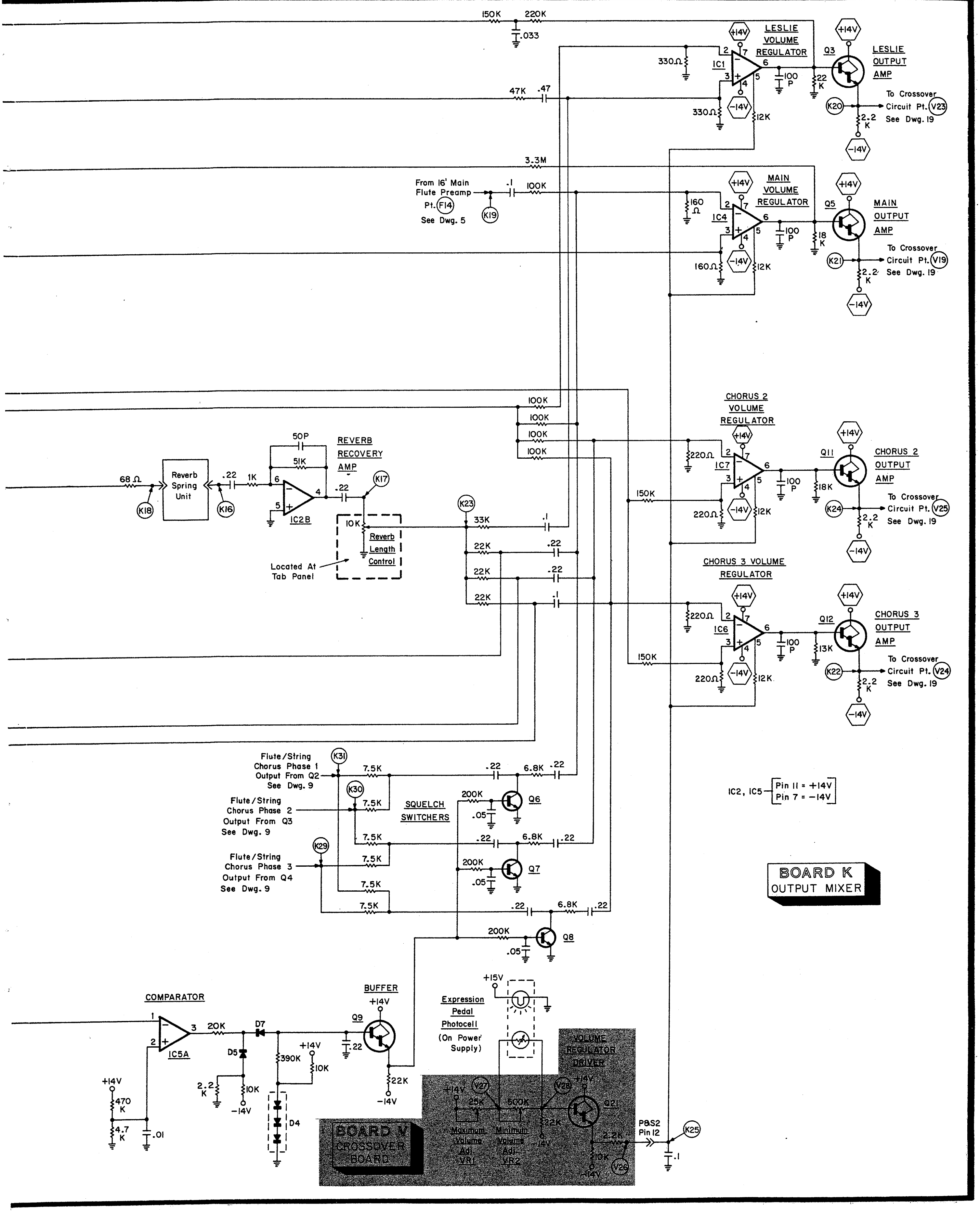
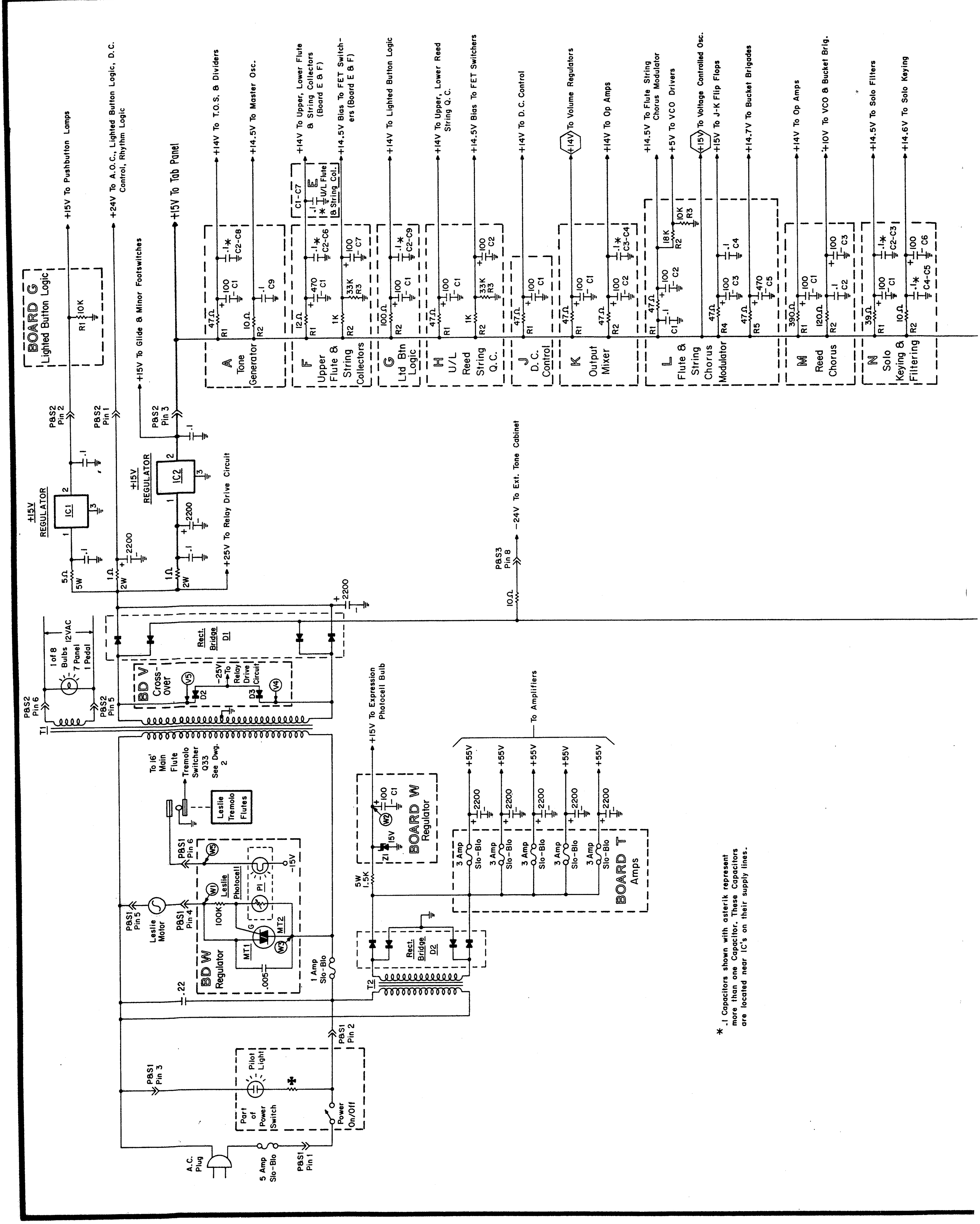

150K
220K
.033
LESLIE VOLUME REGULATOR
+14V
-14V
330Ω
IC1
100 P
22 K
12K
Q3
LESLIE OUTPUT AMP
47K
.47
K20
To Crossover Circuit Pt. V23 See Dwg. 19
2.2 K
3.3M
From 16' Main Flute Preamp Pt. F14 See Dwg. 5
K19
.1
100K
MAIN VOLUME REGULATOR
160 Ω
IC4
18 K
Q5
MAIN OUTPUT AMP
K21
To Crossover Circuit Pt. V19 See Dwg. 19
CHORUS 2 VOLUME REGULATOR
220Ω
IC7
Q11
18K
CHORUS 2 OUTPUT AMP
K24
To Crossover Circuit Pt. V25 See Dwg. 19
150K
CHORUS 3 VOLUME REGULATOR
IC6
Q12
13K
CHORUS 3 OUTPUT AMP
K22
To Crossover Circuit Pt. V24 See Dwg. 19
100K
50P
51K
REVERB RECOVERY AMP
68 Ω
K18
Reverb Spring Unit
K16
.22
1K
IC2B
K17
10K
Reverb Length Control
Located At Tab Panel
K23
33K
22K
.22
.1
Flute/String Chorus Phase 1 Output From Q2 See Dwg. 9
K31
7.5K
6.8K
Flute/String Chorus Phase 2 Output From Q3 See Dwg. 9
K30
SQUELCH SWITCHERS
200K
.05
Q6
Q7
Q8
Flute/String Chorus Phase 3 Output From Q4 See Dwg. 9
K29
IC2, IC5 — Pin 11 = +14V Pin 7 = −14V
BOARD K OUTPUT MIXER
COMPARATOR
IC5A
20K
D7
D5
2.2 K
10K
390K
D4
+14V
470 K
4.7 K
.01
BUFFER
Q9
22K
-14V
+15V
Expression Pedal Photocell (On Power Supply)
VOLUME REGULATOR DRIVER
V27
V28
25K
500K
Q21
Maximum Volume Adj. VR1
Minimum Volume Adj. VR2
2.2K
10K
V26
P&S2 Pin 12
K25
BOARD V CROSSOVER BOARD

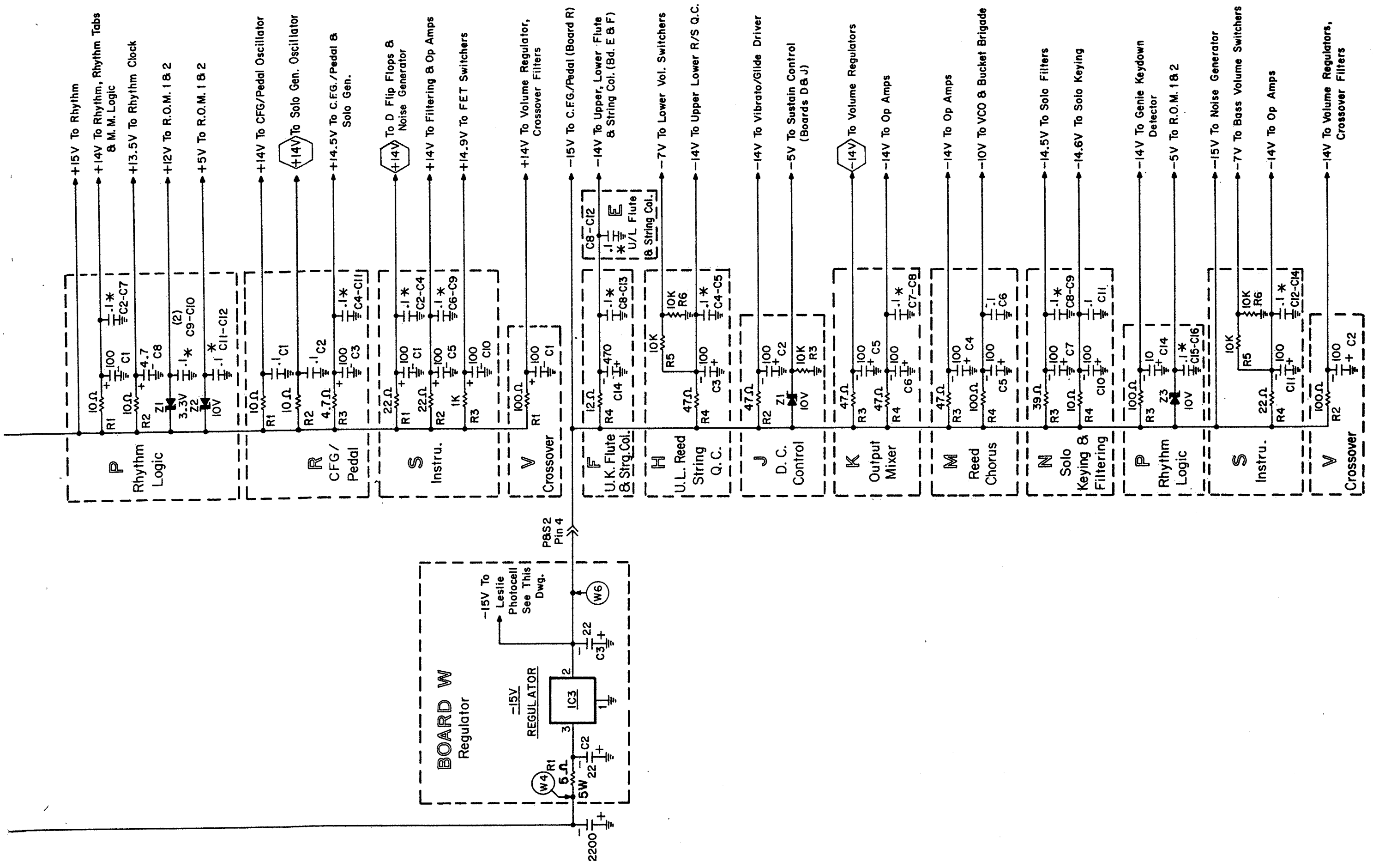
POWER SUPPLY



* .1 Capacitors shown with asterik represent more than one Capacitor. These Capacitors are located near IC's on their supply lines.

+15V To Pushbutton Lamps
+24V To A.O.C., Lighted Button Logic, D.C. Control, Rhythm Logic
+15V To Tab Panel
+14V To T.O.S. & Dividers
+14.5V To Master Osc.
+14V To Upper, Lower Flute & String Collectors (Board E & F)
+14.5V Bias To FET Switchers (Board E & F)
+14V To Lighted Button Logic
+14V To Upper, Lower Reed String Q.C.
+14.5V Bias To FET Switchers
+14V To D.C. Control
+14V To Volume Regulators
+14V To Op Amps
+14.5V To Flute String Chorus Modulator
+5V To VCO Drivers
+15V To Voltage Controlled Osc.
+15V To J-K Flip Flops
+14.7V To Bucket Brigades
+14V To Op Amps
+10V To VCO & Bucket Brig.
+14.5V To Solo Filters
+14.6V To Solo Keying
BOARD G Lighted Button Logic
A Tone Generator
F Upper Flute & String Collectors
G Ltd Btn Logic
H U/L Reed String Q.C.
J D.C. Control
K Output Mixer
L Flute & String Chorus Modulator
M Reed Chorus
N Solo Keying & Filtering
E U/L Flute & String Col.
C1-C7
+15V To Glide & Minor Footswitches
+15V REGULATOR
IC1
IC2
+25V To Relay Drive Circuit
-24V To Ext. Tone Cabinet
P&S2 Pin 2
P&S2 Pin 1
P&S2 Pin 3
P&S2 Pin 5
P&S2 Pin 6
P&S3 Pin 8
1 of 8 Bulbs 7 Panel 1 Pedal
12VAC
Rect. Bridge D1
BD V Cross-over
-25V To Relay Drive Circuit
T1
To 16' Main Flute Tremolo Switcher Q33 See Dwg. 2
Leslie Tremolo Flutes
+15V To Expression Photocell Bulb
To Amplifiers
+55V
3 Amp Slo-Blo
BOARD T Amps
BOARD W Regulator
Z1 15V
5W 1.5K
Rect. Bridge D2
T2
Leslie Photocell
BD W Regulator
Leslie Motor
P&S1 Pin 6
P&S1 Pin 5
P&S1 Pin 4
P&S1 Pin 3
P&S1 Pin 2
P&S1 Pin 1
1 Amp Slo-Blo
Pilot Light
Part of Power Switch
Power On/Off
A.C. Plug
5 Amp Slo-Blo

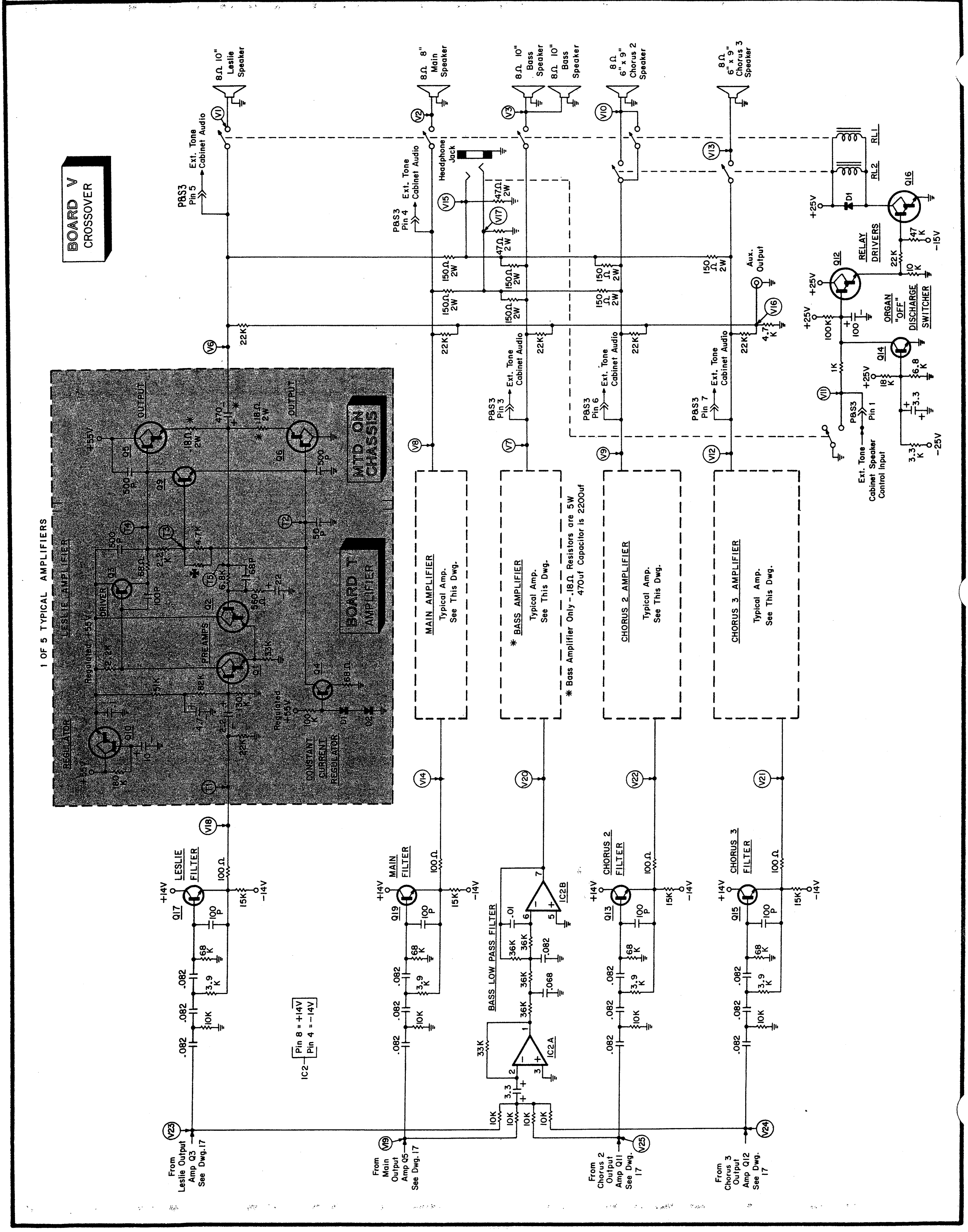
POWER SUPPLY


+15V To Rhythm
+14V To Rhythm, Rhythm Tabs & M.M. Logic
+13.5V To Rhythm Clock
+12V To R.O.M. 1 & 2
+5V To R.O.M. 1 & 2
+14V To CFG/Pedal Oscillator
+14V To Solo Gen. Oscillator
+14.5V To C.FG./Pedal & Solo Gen.
+14V To D Flip Flops & Noise Generator
+14V To Filtering & Op Amps
+14.9V To FET Switchers
+14V To Volume Regulator, Crossover Filters
-15V To C.FG./Pedal (Board R)
-14V To Upper, Lower Flute & String Col. (Bd. E & F)
-7V To Lower Vol. Switchers
-14V To Upper Lower R/S Q.C.
-14V To Vibrato/Glide Driver
-5V To Sustain Control (Boards D & J)
-14V To Volume Regulators
-14V To Op Amps
-14V To Op Amps
-10V To VCO & Bucket Brigade
-14.5V To Solo Filters
-14.6V To Solo Keying
-14V To Genie Keydown Detector
-5V To R.O.M. 1 & 2
-15V To Noise Generator
-7V To Bass Volume Switchers
-14V To Op Amps
-14V To Volume Regulators, Crossover Filters
P Rhythm Logic
R CFG/ Pedal
S Instru.
V Crossover
F U.K. Flute & Strg.Col.
E U/L Flute & String Col.
H U.L. Reed String Q.C.
J D.C. Control
K Output Mixer
M Reed Chorus
N Solo Keying & Filtering
P Rhythm Logic
S Instru.
V Crossover
PBS2 Pin 4
BOARD W Regulator
-15V REGULATOR
IC3
-15V To Leslie Photocell See This Dwg.
W6
W4
R1 5Ω 5W
C2 22
C3 22
2200

POWER SUPPLY CHASSIS

19

CROSSOVER FILTERS & AMPLIFIERS


BOARD V
CROSSOVER
1 OF 5 TYPICAL AMPLIFIERS
LESLIE AMPLIFIER
REGULATOR
Regulated +55V
DRIVER
PREAMPS
OUTPUT
CONSTANT CURRENT REGULATOR
MTD ON CHASSIS
BOARD T
AMPLIFIER
8Ω 10" Leslie Speaker
8Ω 8" Main Speaker
8Ω 10" Bass Speaker
8Ω 10" Bass Speaker
8Ω 6" x 9" Chorus 2 Speaker
8Ω 6" x 9" Chorus 3 Speaker
Ext. Tone Cabinet Audio
P8S3 Pin 5
P8S3 Pin 4
P8S3 Pin 3
P8S3 Pin 6
P8S3 Pin 7
P8S3 Pin 1
Headphone Jack
Aux. Output
RL1
RL2
Q16
Q12
Q14
RELAY DRIVERS
ORGAN "OFF" DISCHARGE SWITCHER
Ext. Tone Cabinet Speaker Control Input
+25V
-15V
-25V
MAIN AMPLIFIER
Typical Amp. See This Dwg.
* BASS AMPLIFIER
Typical Amp. See This Dwg.
* Bass Amplifier Only - .18Ω Resistors are 5W
470uf Capacitor is 2200uf
CHORUS 2 AMPLIFIER
Typical Amp. See This Dwg.
CHORUS 3 AMPLIFIER
Typical Amp. See This Dwg.
LESLIE FILTER
MAIN FILTER
CHORUS 2 FILTER
CHORUS 3 FILTER
BASS LOW PASS FILTER
IC2A
IC2B
IC2 - Pin 8 = +14V
Pin 4 = -14V
Q17
Q19
Q13
Q15
+14V
-14V
From Leslie Output Amp Q3 See Dwg. 17
From Main Output Amp Q5 See Dwg. 17
From Chorus 2 Output Amp Q11 See Dwg. 17
From Chorus 3 Output Amp Q12 See Dwg. 17
V1
V2
V3
V6
V7
V8
V9
V10
V11
V12
V13
V14
V15
V16
V17
V18
V19
V20
V21
V22
V23
V24
V25
T1
T2
T3
T4
T5
150Ω 2W
47Ω 2W
22K
4.7K
100Ω
15K
.082
68K
3.9K
10K
100P
36K
33K
.01
.068
3.3
D1

TRANSISTOR BASING DIAGRAM

FIG. A

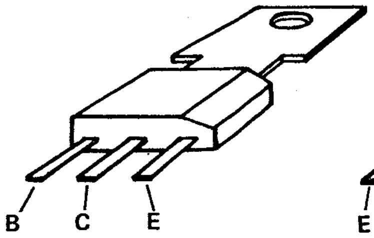


FIG. B

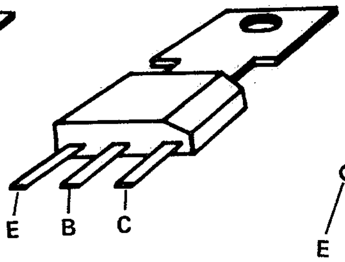


FIG. C

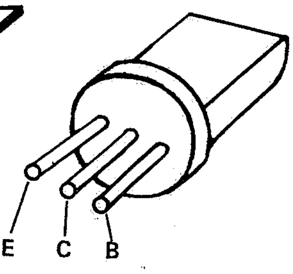


FIG. D

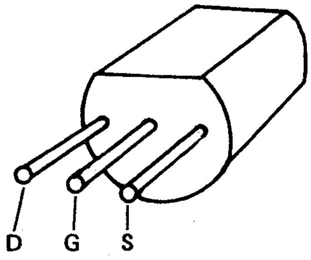


FIG. E

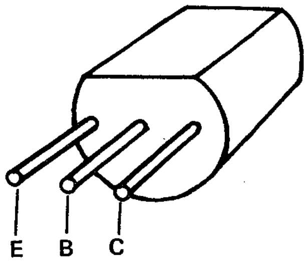


FIG. F

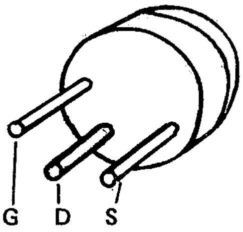


FIG. G

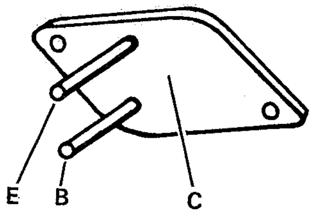


FIG. H

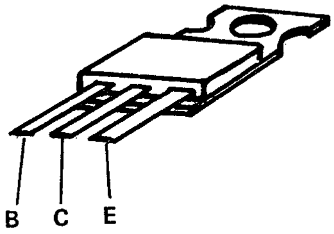


FIG. J

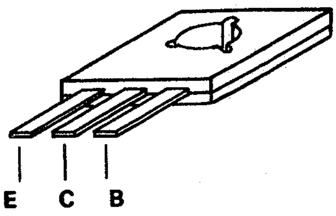


FIG. K

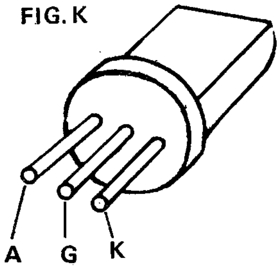


FIG. L

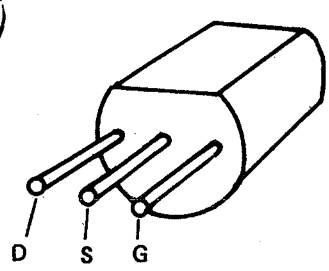
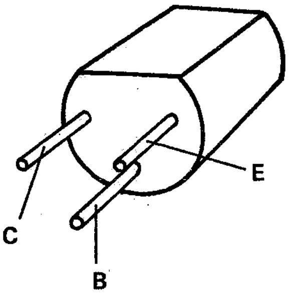


FIG. M



PART NUMBER	FIGURE	PART NUMBER	FIGURE	PART NUMBER	FIGURE	PART NUMBER	FIGURE
992-001192	G	991-012328	F	991-016727	C	992-024185	G
991-002232	C	991-012396	F	991-016788	C	991-024184	C
991-002271	G	991-012686	F	992-017169	G	991-025535	E or M
991-002298	C	992-013170	A	991-017456	F	991-026039	G
991-002356	C	991-013543	C	991-018238	C	991-026040	G
991-002873	C	991-013544	C	991-018047	E	991-026028	G
991-002888	C	991-013599	C	991-018237	B	991-026054	C
992-003139	G	991-015000	A	991-018493	E	991-026617	C
991-003304	C	991-015001	A	992-020432	G	991-026315	C
991-008393	C	991-015062	A	991-020425	H	991-028269	L
991-008394	C	991-015063	A	991-020426	H	991-028691	C
992-008890	G	991-015316	K	992-022201	G		
991-010098	C	991-015587	C	991-021451	J		
991-010462	C	991-015614	C	991-021450	J		
991-011576	D	991-015663	C	992-022773	G		
991-011706	D	991-016274	C	991-022774	L		

TRUTH TABLES

LOWREY PART NO.	MFG. PART. NO.	FIG.
991-025515	CD4011	1
991-025516	CD4071	2
991-025517	CD4081	3
991-025599	CD4532	4
991-026006	CD4520	5
991-026022	CD4027	6
991-026025	CD4001	7
991-027358	CD4013	8
991-028682-001	CD4025	9
991-028684-001	CD4073	10
991-028689-001	CD4512	11

FIG. 1

NAND

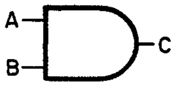
A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

FIG. 2

OR

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

FIG. 3



AND

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

FIG. 4

PRIORITY ENCODER

	INPUT									OUTPUT				
Pin No →	5	4	3	2	1	13	12	11	10	14	6	7	9	15
	0	X	X	X	X	X	X	X	X	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	1	1	X	X	X	X	X	X	X	1	1	1	1	0
	1	0	1	X	X	X	X	X	X	1	1	1	0	0
	1	0	0	1	X	X	X	X	X	1	1	0	1	0
	1	0	0	0	1	X	X	X	X	1	1	0	0	0
	1	0	0	0	0	1	X	X	X	1	0	1	1	0
	1	0	0	0	0	0	1	X	X	1	0	1	0	0
	1	0	0	0	0	0	0	1	X	1	0	0	1	0
	1	0	0	0	0	0	0	0	1	1	0	0	0	0

X = Don't Care

FIG. 5

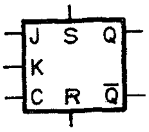
COUNTER

CLOCK	ENABLE	RESET	ACTION
↑	1	0	Counter
0	↓	0	Counter
↑	0	0	No Change
1	↓	0	No Change
X	X	1	Q1–Q4=0

X = Don't Care

TRUTH TABLES

FIG. 6

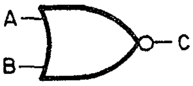


J-K FLIP-FLOP

T_n					T_n+1	
J	K	S	R	Clk	Q	$\overline{Q}$
1	0	0	0	↑	1	0
0	1	0	0	↑	0	1
0	0	0	0	↑	Q_n	$\overline{Q}_n$
1	1	0	0	↑	$\overline{Q}_n$	Q_n
X	X	0	1	X	0	1
X	X	1	0	X	1	0
X	X	1	1	X	1	1

X = Don't Care

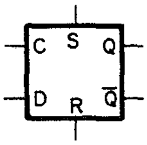
FIG. 7



NOR

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

FIG. 8

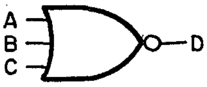


D FLIP-FLOP

T_n				T_n+1	
D	S	R	Clk	Q	$\overline{Q}$
1	0	0	↑	1	0
0	0	0	↑	0	1
X	0	1	X	0	1
X	1	0	X	1	0
X	1	1	X	1	1

X = Don't Care

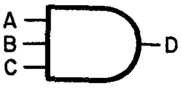
FIG. 9



TRIPLE-INPUT NOR

A	B	C	D
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

FIG. 10



TRIPLE-INPUT AND

A	B	C	D
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

FIG. 11

SELECTOR

Pin No. →

INPUT			INHIBIT	DISABLE	OUTPUT
13	12	11	10	15	14
0	0	0	0	0	D0
0	0	1	0	0	D1
0	1	0	0	0	D2
0	1	1	0	0	D3
1	0	0	0	0	D4
1	0	1	0	0	D5
1	1	0	0	0	D6
1	1	1	0	0	D7
X	X	X	1	0	0
X	X	X	X	1	HIGH Z

X = Don't Care

FREQUENCY DISTRIBUTION CHART

UPPER KEYBOARD

Octave Frequency of Audio Signal

Voice Footages	16'	8'	4'	2 2/3'	2'	1'
F1	F2	F3	F4	C5	F5	F6
F#1	F#2	F#3	F#4	C#5	F#5	F#6
G1	G2	G3	G4	D5	G5	G6
G#1	G#2	G#3	G#4	D#5	G#5	G#6
A1	A2	A3	A4	E5	A5	A6
A#1	A#2	A#3	A#4	F5	A#5	A#6
B1	B2	B3	B4	F#5	B5	B6
C1	C3	C4	C5	G5	C6	C7
C#1	C#3	C#4	C#5	G#5	C#6	C#7
D1	D3	D4	D5	A5	D6	D7
D#1	D#3	D#4	D#5	A#5	D#6	D#7
E1	E3	E4	E5	B5	E6	E7
F2	F3	F4	F5	C6	F6	F7
F#2	F#3	F#4	F#5	C#6	F#6	F#7
G2	G3	G4	G5	D6	G6	G7
G#2	G#3	G#4	G#5	D#6	G#6	G#7
A2	A3	A4	A5	E6	A6	A7
A#2	A#3	A#4	A#5	F6	A#6	A#7
B2	B3	B4	B5	F#6	B6	B7
C2	C4	C5	C6	G6	C7	C8
C#2	C#4	C#5	C#6	G#6	C#7	C#8
D2	D4	D5	D6	A6	D7	D8
D#2	D#4	D#5	D#6	A#6	D#7	D#8
E2	E4	E5	E6	B6	E7	E8
F3	F4	F5	F6	C7	F7	F8
F#3	F#4	F#5	F#6	C#7	F#7	F#8
G3	G4	G5	G6	D7	G7	G8
G#3	G#4	G#5	G#6	D#7	G#7	G#8
A3	A4	A5	A6	E7	A7	A8
A#3	A#4	A#5	A#6	F7	A#7	A#8
B3	B4	B5	B6	F#7	B7	B8
C3	C5	C6	C7	G7	C8	C9
C#3	C#5	C#6	C#7	G#7	C#8	C#8
D3	D5	D6	D7	A7	D8	D8
D#3	D#5	D#6	D#7	A#7	D#8	D#8
E3	E5	E6	E7	B7	E8	E8
F4	F5	F6	F7	C8	F8	F8
F#4	F#5	F#6	F#7	C#8	F#8	F#8
G4	G5	G6	G7	D8	G8	G8
G#4	G#5	G#6	G#7	D#8	G#8	G#8
A4	A5	A6	A7	E8	A8	A8
A#4	A#5	A#6	A#7	F8	A#8	A#8
B4	B5	B6	B7	F#8	B8	B8
C4	C6	C7	C8	G8	C9	C9

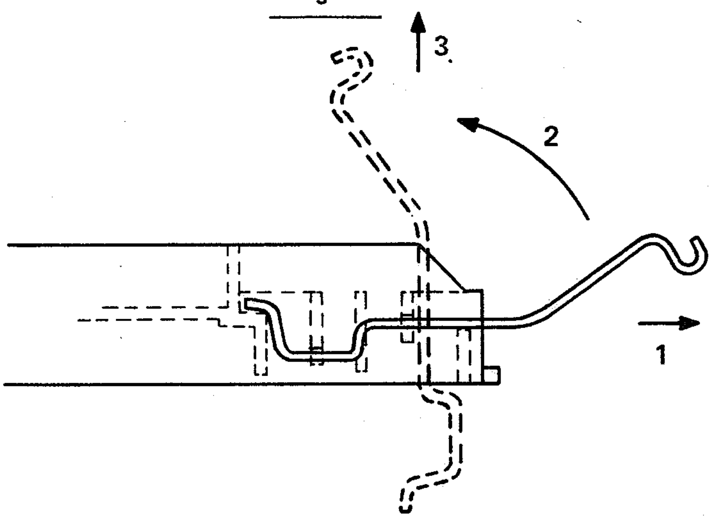
LOWER KEYBOARD

Octave Frequency of Audio Signal

Voice Footages	4'	8'
A1	A3	A2
A#1	A#3	A#2
B1	B3	B2
C1	C4	C3
C#1	C#4	C#3
D1	D4	D3
D#1	D#4	D#3
E1	E4	E3
F1	F4	F3
F#1	F#4	F#3
G1	G4	G3
G#1	G#4	G#3
A2	A4	A3
A#2	A#4	A#3
B2	B4	B3
C2	C5	C4
C#2	C#5	C#4
D2	D5	D4
D#2	D#5	D#4
E2	E5	E4
F2	F5	F4
F#2	F#5	F#4
G2	G5	G4
G#2	G#5	G#4
A3	A5	A4
A#3	A#5	A#4
B3	B5	B4
C3	C6	C5
C#3	C#6	C#5
D3	D6	D5
D#3	D#6	D#5
E3	E6	E5
F3	F6	F5
F#3	F#6	F#5
G3	G6	G5
G#3	G#6	G#5
A4	A6	A5
A#4	A#6	A#5
B4	B6	B5
C4	C7	C6
C#4	C#7	C#6
D4	D7	D6
D#4	D#7	D#6
E4	E7	E6

KEYSWITCH ACTUATOR REPLACEMENT

Fig. 1

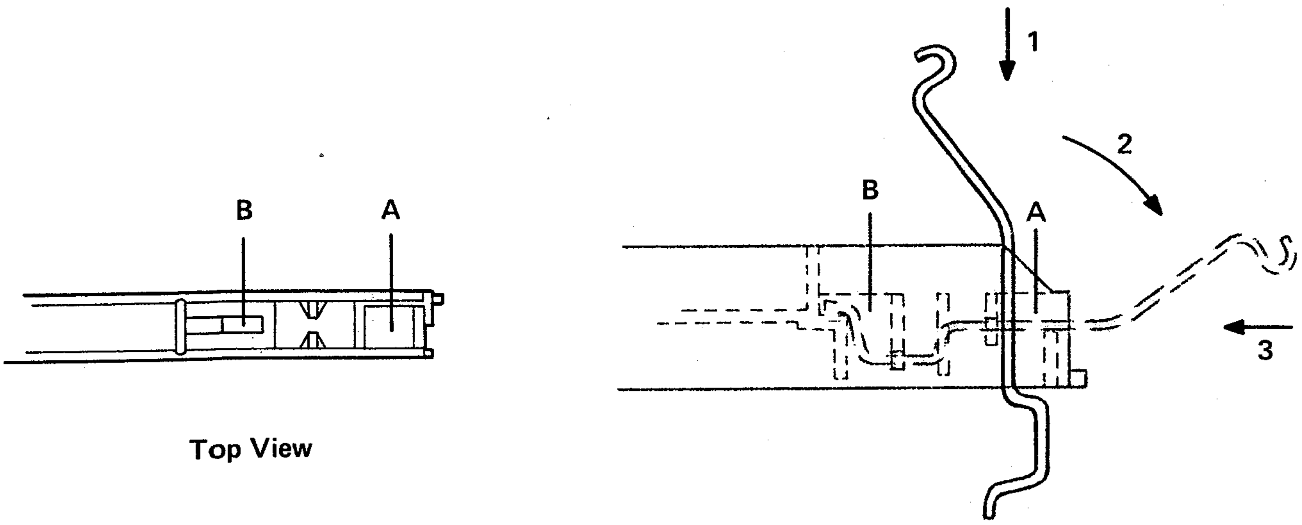


Side View

To remove wire actuator

1. Using pliers, pull wire actuator outward until it stops.
2. Rotate upward to a vertical position.
3. Lift wire actuator vertically from key.

Fig. 2



Top View

Side View

To replace wire actuator

1. Holding hooked end, insert wire actuator vertically into opening A.
2. Rotate downward so that straight end positions into Slot B.
3. Using pliers, push wire actuator inward until it stops.

Intro I

	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	High Drum	●																●															
	Snare	●						●		●						●		●		●				●				●		●		●	
	Bongo									●						●												●					
	Cymbal	●								●																							
	Tom Tom																													●		●	
	Bass Drum																															●	
Swing Bass	8th	●																															
	6th/-7th									●																						●	
	5th																											●		●			
	2nd																	●		●													
	Snub																	●										●				●	

Intro II

	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	Snare			●	●		●			●	●		●	●	●	●	●	●	●	●			●		●
	Low Drum																●	●							
	Bongo																●	●	●				●		
	Tom Tom																			●					
	Cymbal	●						●												●			●		●
	Cymbal Snub																						●		●
	Bass Drum	●						●						●						●					
Swing Bass	5th																						●		
	3rd/–3rd																			●					
	2nd															●									

RHYTHM PATTERN CHARTS

RHYTHM 1

TRACK A

Ballad	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	Snare							●												●					
	Cymbal																							●	
	Brush	●		●	●	●		●		●		●		●		●	●	●		●		●		●	
	Brush Snub	●		●	●	●		●		●		●		●		●	●	●		●		●		●	
	Bass Drum	●										●		●										●	
Lower Keyboard	Chord	●						●				●		●						●		●		●	
	* Accent							●												●					
	Chord Sustain	●										●		●										●	
Genie Bass	5th													●						●				●	
	Root	●						●																	
Magic Melody	5th							●												●					
	3rd/–3rd					●				●								●				●			
	Root			●				●				●				●				●				●	
	Low 5th	●				●				●				●				●				●			
	Lo 3rd/Lo –3rd			●								●				●								●	
	Low Root	●												●											
Swing Bass	5th													●										●	
	3rd/–3rd							●												●					
	Root	●																							

TRACK B

Tango	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare	●				●				●				●		●	●	●				●				●				●		●	●
	Cymbal															●																●	
	Bass Drum	●				●				●				●		●		●				●				●				●		●	
Lower Keyboard	Chord	●				●				●				●		●				●				●		●				●		●	
	* Accent															●																●	
	Chord Sustain															●																●	
Genie Bass	5th									●				●												●				●			
	Root	●				●												●				●											
Magic Melody	3rd/–3rd													●																●			
	Root	●								●								●								●							
	Low 5th							●						●										●						●			
	Lo 3rd/Lo –3rd	●								●								●								●							
	Low Root							●																●									
	Snub							●		●				●										●		●				●			
Swing Bass	5th									●								●															
	3rd/–3rd					●								●								●								●			
	Root	●																								●							

TRACK C

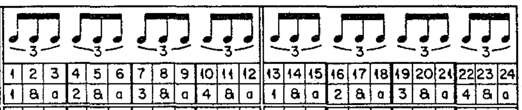
Rock	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare					●								●								●								●			
	Cymbal	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Cymbal Snub	●		●		●		●		●				●		●		●		●		●		●		●				●		●	
	Bass Drum	●						●		●								●						●		●							
Lower Keyboard	Chord					●		●						●								●		●						●			
	* Accent													●																●			
	Chord Sustain					●								●								●								●			
Genie Bass	5th									●																●							
	Root	●						●										●						●									
Magic Melody	Root	●		●						●		●						●		●						●		●					
	Lo 6th/Lo –7th							●								●								●								●	
	Low 5th					●								●								●								●			
	Lo 3rd/Lo –3rd	●		●						●		●						●		●						●		●					
	Snub	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
Swing Bass	8th																	●															
	7th																					●											
	6th/–7th													●										●									
	5th									●						●										●						●	
	3rd/–3rd					●		●																						●			
	Root	●																															
	Snub					●		●						●		●						●		●						●		●	

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

RHYTHM PATTERN CHARTS

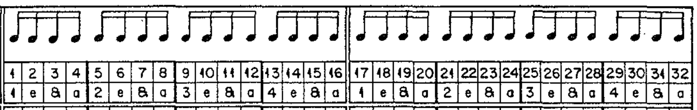
RHYTHM 2

TRACK A



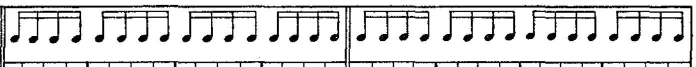
Dixie	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	Snare				●						●						●					●	●		
	Cymbal	●			●		●	●			●		●	●			●		●	●			●		●
	Cymbal Snub				●		●				●		●				●		●				●		●
	Brush				●						●						●						●		
	Brush Snub				●						●						●						●		
	Bass Drum	●						●						●						●					
Lower Keyboard	Chord	●			●			●			●			●			●			●		●	●		
	* Accent				●						●						●						●		
	Chord Sustain	●						●						●						●		●			
Genie Bass	5th							●												●					
	Root	●												●											
Magic Melody	*3rd/–3rd*	●					●				●			●			●								
	Root				●					●										●			●		
	Low 5th			●				●					●			●			●			●			●
	Snub			●			●			●			●			●			●			●			●
Swing Bass	8th													●											
	5th										●						●								
	3rd/–3rd							●												●					●
	2nd				●																		●		
	Root	●																							
	Snub																								●

TRACK B



Samba	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	High Drum									●																		●					
	Low Drum									●																		●					
	Tom Tom									●																●							
	Bongo	●						●										●		●				●									
	Snare	●				●										●				●				●						●			
	Cymbal	●						●		●						●		●						●		●						●	
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub					●		●						●		●						●		●						●		●	
	Bass Drum	●								●								●								●							
Lower Keyboard	Chord	●				●				●		●				●				●				●				●		●			
	* Accent	●				●										●				●				●									
	Chord Sustain									●						●								●									
Genie Bass	5th									●																●							
	Root	●																●															
Magic Melody	Lo 6th/Lo –7th									●																●				●			
	Low 5th	●				●										●				●				●									
	Lo 3rd/Lo –3rd	●				●				●						●				●				●		●				●			
	Snub																							●									
Swing Bass	*8th*	●						●										●						●									
	5th									●																●							
	Snub							●																●									

TRACK C



Hard Rock	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare					●								●								●								●			
	Low Drum								●																●		●						
	Cymbal								●							●									●		●					●	
	Cymbal Snub								●																●		●						
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Bass Drum	●		●						●		●						●		●						●		●					
Lower Keyboard	Chord					●			●					●								●			●					●			
	* Accent													●																●			
	Chord Sustain					●								●								●								●			
Genie Bass	5th									●																●							
	Root	●		●														●		●													
Magic Melody	Root					●								●		●						●				●				●		●	
	Lo 6th/Lo –7th															●																●	
	Low 5th			●		●								●						●		●				●				●			
	Low Root	●										●						●							●			●					
	Snub	●		●								●				●		●		●					●	●		●				●	
Swing Bass	8th					●																●											
	–7th															●										●							
	6th/–7th																										●						
	5th			●								●		●											●			●				●	
	3rd/–3rd																													●			
	Root	●																●															
	Snub	●		●								●		●											●	●	●	●				●	

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

RHYTHM PATTERN CHARTS

RHYTHM 3

TRACK A

Swing	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	High Drum										●												●		
	Rim Shot										●												●		
	Cymbal	●			●		●	●			●		●	●			●		●	●		●	●		●
	Cymbal Snub				●		●				●		●				●		●				●		
	Bass Drum	●			●			●			●			●			●			●			●		
Lower Keyboard	Chord	●					●				●						●					●			
	* Accent	●									●						●								
	Chord Sustain																●								
Genie Bass	5th							●			●									●			●		
	Root	●			●									●			●								
Magic Melody	Root				●					●				●					●				●		
	Low 5th			●				●					●												
	Lo 3rd/Lo −3rd	●					●				●			●					●				●		
	Snub			●			●			●			●	●									●		
Swing Bass	8th				●																				
	5th							●					●										●		
	3rd/−3rd										●									●					
	2nd																●								
	Root	●												●											
	Snub												●												

TRACK B

Bosa Nova	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Block	●						●						●								●						●					
	High Drum	●						●						●								●						●					
	Cymbal							●								●								●								●	
	Cymbal Snub							●								●								●								●	
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub					●		●						●		●						●		●						●		●	
	Bass Drum	●						●		●								●						●		●							
Lower Keyboard	Chord	●				●						●				●				●				●				●		●			
	* Accent	●				●										●								●				●					
	Chord Sustain					●										●				●													
Genie Bass	5th									●																●							
	Root	●						●										●						●									
Magic Melody	Root	●				●										●				●				●									
	Low 5th									●																		●		●			
	Snub																											●					
Swing Bass	8th															●		●												●			
	5th							●		●														●		●							
	Root	●																															
	Snub							●								●								●									

TRACK C

Soft Rock	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare									●																●							
	Cymbal																															●	
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Bass Drum	●				●										●				●				●									
Lower Keyboard	Chord	●				●				●						●				●				●		●				●			
	* Accent									●																●				●			
	Chord Sustain	●				●				●						●										●							
Genie Bass	5th									●																●							
	Root	●				●										●				●				●									
Magic Melody	Root	●				●		●		●						●		●		●				●		●				●			
	Lo 6th/Lo −7th	●				●		●										●		●				●									
	Low 5th									●						●										●							
	Snub					●		●										●		●				●						●			
Swing Bass	8th															●				●				●									
	−7th											●														●							
	5th									●																				●			
	Root	●						●																									
	Snub							●		●														●									

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

RHYTHM PATTERN CHARTS

RHYTHM 4

TRACK A

Country	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	High Drum				●												●								
	Low Drum				●		●										●		●						
	Snare										●												●		
	Brush	●		●	●		●	●		●	●		●	●		●	●		●	●		●	●		●
	Brush Snub				●		●				●		●				●		●				●		●
	Bass Drum	●					●	●						●					●	●					
Lower Keyboard	Chord	●			●		●	●			●		●	●			●		●	●		●	●		●
	* Accent				●		●				●		●				●		●				●		●
	Chord Sustain	●						●						●						●		●			
Genie Bass	5th							●												●					
	Root	●												●											
Magic Melody	Root	●												●											
	Low 5th							●															●		
	Lo 3rd/Lo –3rd	●												●						●					
	Low Root							●									●								
Swing Bass	8th	●																							
	5th							●															●		
	3rd/–3rd																			●					
	Root													●											

TRACK B

Rhumba	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Clave	●						●						●								●				●							
	High Drum	●								●								●								●							
	Low Drum			●		●		●				●				●				●		●		●				●				●	
	Bongo													●																●		●	
	Tom Tom	●																●															
	Brush	●		●	●	●		●		●		●		●		●		●		●	●	●		●		●		●		●		●	
	Brush Snub	●		●	●	●		●		●		●		●		●		●		●	●	●		●		●		●		●		●	
	Bass Drum	●								●				●				●								●				●			
Lower Keyboard	Chord			●				●				●				●				●				●				●				●	
	* Accent			●				●												●				●									
	Chord Sustain			●																●													
Genie Bass	5th									●				●												●				●			
	Root	●																●															
Magic Melody	5th			●										●						●										●			
	3rd/–3rd,				●							●				●					●							●				●	
	Root			●		●				●				●						●		●				●				●			
	Low 5th				●			●				●				●					●			●				●				●	
	Lo 3rd/Lo –3rd					●				●												●				●							
	Low Root							●																●									
Swing Bass	5th													●																●			
	3rd/–3rd									●																●							
	Root	●																●															

TRACK C

Disco	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare									●																●							
	Low Drum							●																●						●			
	Cymbal					●								●								●								●			
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Bass Drum	●								●								●								●							
Lower Keyboard	Chord	●						●		●						●		●		●				●		●				●			
	* Accent							●		●														●		●							
	Chord Sustain	●								●								●								●							
Genie Bass	5th									●																●							
	Root	●																●															
Magic Melody	Root	●								●						●				●				●									
	Lo 6th/Lo –7th							●																		●							
	Low 5th					●								●																●			
	Snub	●				●		●						●						●				●									
Swing Bass	8th	●																●						●									
	6th/–7th																													●			
	5th									●																●							
	Snub																							●									

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

RHYTHM PATTERN CHARTS

RHYTHM 5

TRACK A

Swing Waltz	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	1	&	a	2	&	a	3	&	a
Instrumentation	Snare			●				●					●				●		
	Cymbal	●		●	●		●	●		●	●		●	●		●	●		●
	Cymbal Snub			●			●			●			●			●			●
	Bass Drum	●					●				●								
Lower Keyboard	Chord			●	●			●					●	●			●		
	* Accent				●			●						●			●		
	Chord Sustain							●						●					
Genie Bass	5th										●								
	Root	●					●												
Magic Melody	Root			●				●					●				●		
	Low 5th			●									●						
	Lo 3rd/Lo –3rd							●									●		
	Low Root	●					●				●					●			
	Snub			●			●						●			●			
Swing Bass	8th	●					●												
	5th										●								

TRACK B

Cha Cha	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Clave	●								●								●								●				●		●	
	Block	●				●				●				●				●				●				●				●		●	
	High Drum					●								●								●								●			
	Low Drum	●		●				●		●		●				●		●		●				●		●		●				●	
	Bongo	●								●								●								●							
	Tom Tom							●								●								●						●		●	
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub					●		●						●		●						●		●						●		●	
	Bass Drum	●												●				●												●			
Lower Keyboard	Chord	●				●				●				●				●				●				●				●		●	
	* Accent	●								●								●								●							
	Chord Sustain	●				●				●				●				●				●				●							
Genie Bass	5th									●				●												●				●			
	Root	●						●										●						●									
Magic Melody	Root					●																●											
	Lo 6th/Lo –7th																															●	
	Low 5th													●		●														●			
	Lo 3rd/Lo –3rd									●																●							
	Low Root	●																●															
	Snub													●		●														●		●	
Swing Bass	Hi 5th							●																●									
	8th	●																●															
	6th/–7th													●																●			
	5th									●																●							
	Snub							●																●									

TRACK C

March	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Snare	●				●				●				●				●				●		●		●				●	●	●	●
	Brush	●								●								●								●							
	Bass Drum	●								●								●								●							
Lower Keyboard	Chord	●				●				●				●				●				●		●		●				●		●	
	* Accent					●								●								●								●		●	
	Chord Sustain	●								●								●								●							
Genie Bass	5th									●																●							
	Root	●																●															
Magic Melody	3rd/–3rd																									●							
	Root																	●						●						●			
	Low 5th									●						●						●											
	Lo 3rd/Lo –3rd	●						●						●																			
	Low Root					●																											
	Snub					●		●						●		●						●		●						●			
Swing Bass	8th	●																●															
	6th/–7th																									●							
	5th									●												●								●			

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

RHYTHM PATTERN CHARTS

RHYTHM 6

TRACK A

Waltz	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	RHYTHM COUNT	1	&	a	2	&	a	3	&	a	1	&	a	2	&	a	3	&	a
Instrumentation	Snare				●			●					●	●			●		
	Cymbal	●									●								
	Bass Drum	●									●								
Lower Keyboard	Chord				●			●					●	●			●		
	* Accent				●			●						●			●		
	Chord Sustain							●									●		
Genie Bass	5th										●								
	Root	●																	
Magic Melody	3rd/–3rd													●			●		
	Root				●			●						●			●		
	Low 5th				●			●					●						
	Lo 3rd/Lo –3rd			●							●								
	Low Root	●																	
	Snub			●	●								●	●					
Swing Bass	5th										●								
	Root	●																	

TRACK B

Latin Rock	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Clave	●				●				●				●				●				●				●				●			
	Block	●				●				●				●				●				●				●				●			
	High Drum			●		●						●		●						●		●						●		●			
	Low Drum					●		●						●		●						●		●						●		●	
	Snare					●								●								●								●			
	Bongo					●																●											
	Tom Tom													●		●														●			
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Snub					●		●						●		●						●		●						●		●	
	Bass Drum	●								●				●				●								●				●			
Lower Keyboard	Chord	●				●				●		●				●		●				●		●		●		●				●	
	* Accent					●						●										●						●					
	Chord Sustain	●				●						●						●				●						●					
Genie Bass	5th									●				●												●				●			
	Root	●																●															
Magic Melody	5th			●		●														●		●											
	3rd/–3rd			●		●														●		●											
	Root													●																●			
	Low 5th													●																●			
	Snub			●																●													
Swing Bass	8th															●																●	
	–7th													●																●			
	5th							●		●														●		●							
	Root	●																●															
	Snub							●								●								●								●	

TRACK C

Metronome	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Clave					●								●								●								●			
	Block	●								●								●								●							
Lower Keyboard	Chord					●								●								●								●			
	* Accent													●																●			
	Chord Sustain					●								●								●								●			
Genie Bass	5th									●																●							
	Root	●																●															
Magic Melody	5th	●																●															
	3rd/–3rd									●																●							
	Root					●																●											
	Low 5th													●																●			
	Snub	●				●				●				●				●				●				●				●			
Swing Bass	5th									●																●							
	3rd/–3rd																	●															
	Root	●																															

*Accent refers to Lower Keyboard Accent Circuit located on Drawing 8.

PARTS INFORMATION

STANDARD PARTS

Replacements for all standard electronic parts and hardware may be purchased directly from local suppliers generally in less time than would be required to obtain them from the factory.

SPECIAL PARTS

In addition to the standard replacement parts, special electronic and mechanical parts are also used. These parts are manufactured by and to the specifications of the factory. Order these parts directly from the factory since they would be difficult or impossible to obtain from other sources.

PARTS ORDERING INFORMATION

When ordering parts be sure to include the following information:

1. Model and Serial Number
2. Part Number
3. A description of the part
4. Specify how you want the part shipped.

Most special electronic parts and mechanical parts will have a part number stamped on them. In the event that the part number is missing, or you are unable to read the part number, a complete description of the part and where it is used will allow the factory to fill your parts order. When parts are ordered in the proper manner the factory is able to fill your orders promptly—delays that might result are avoided.

ADDRESS PARTS ORDERS TO:

LOWREY SERVICE PARTS DEPARTMENT
1300 Naperville Drive
Romeoville, Illinois 60441

IMPORTANT

IN ANY CORRESPONDENCE CONCERNING THIS INSTRUMENT ALWAYS INCLUDE MODEL AND SERIAL NUMBERS

PARTS LIST

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THE PARTS LIST CONTAINS THE FOLLOWING INFORMATION:

1. Name of Part
2. Value, Tolerance and Code (When Important)
3. Brief description
4. Where the part is found (assembly, printed circuit board, etc.)
5. Schematic Reference Number
6. PART NUMBER – USE IT!

This parts list includes all standard stock replacement parts. No attempt has been made to include every nut, bolt and screw. If the necessity for a non-listed part arises, please write describing the parts location and function as well as model and serial number of the unit.

PARTS LIST

BOARD A
Tone Generator

Capacitors	Electrolytic	
C1	100 uf 16V	945-025783-006
	Metal Polyester 20% 50V	
	.01 uf	946-026795-103
	.022 uf	946-026795-223
	.0022 uf	946-026795-222
	.0047 uf	946-026795-472
	Polystyrene 10% 50V	
	.01 uf	946-026037-103
	.001 uf	946-026037-102
Coil		
L1	Oscillator	952-018874-002
Diodes		
D1		919-024117
All others		919-024769
Integrated Circuits		
IC1-12	Divider	991-028681-001
IC13	TOS	991-027326
IC14	Hex Inverter	991-027359-002
Network		949-024536
Sockets	14-Pin	906-018905
	16-Pin	906-018905-001

BOARD B
Upper/Lower Diode Keying

Capacitors	Metal Polyester 20% 50V	
	.01 uf	946-026795-103
	.015 uf	946-026795-153
	.0015 uf	946-026795-152
	.0022 uf	946-026795-222
	.0033 uf	946-026795-332
	.0047 uf	946-026795-472
	.0068 uf	946-026795-682
Networks	14-Pin	949-022779
	8-Pin	949-022778
Diodes		
All		919-024769

BOARD C
Upper 1' & 2' Diode Keying

Diodes		
All		919-024769

BOARD C (Continued)

Networks	14-Pin	949-022779
	8-Pin	949-022778

BOARD D
Keyer Control & AOC

Capacitors	Electrolytic	
	2.2 uf 25V	945-026783-001
	47 uf 25V	945-026783-021
Diodes		
All		919-024769
Potentiometer		
VR1	5K 20%	925-004399-005
Transistors		
Q1-41		991-010098
Q42-85		991-010098-004
Q86		991-020425-001
Q88-110		991-010098
Q111		991-002232
Q112		991-010098

BOARD E
Upper/Lower Flute & String Collectors

Capacitors	Electrolytic	
	1 uf 50V	945-026783-014
	2.2 uf 16V	945-028285-002
	Metal Polyester 5% 50V	
	.1 uf	946-026745-104
	.01 uf	946-026745-103
	.012 uf	946-026745-123
	.0012 uf	946-026745-122
	.015 uf	946-026745-153
	.15 uf	946-026745-154
	.0015 uf	946-026745-152
	.18 uf	946-026745-184
	.018 uf	946-026745-183
	.001 uf	946-026745-102
	.22 uf	946-026745-224
	.27 uf	946-026745-274
	.027 uf	946-026745-273
	.39 uf	946-026745-394
	.039 uf	946-026745-393
	.0022 uf	946-026745-222
	.022 uf	946-026745-223
	.033 uf	946-026745-333
	.047 uf	946-026745-473
	.0047 uf	946-026745-472
	.056 uf	946-026745-563
	.0068 uf	946-026745-682

PARTS LIST

BOARD E
Upper/Lower Flute & String Collector (Continued)

Capacitors	**Metal Polyester 5% 50V**	
	.068 uf	946-026745-683
	.082 uf	946-026745-823
	Metal Polyester 20% 50V	
	.1 uf	946-026795-104
	.047 uf	946-026795-473
	.47 uf	946-026795-474
	.22 uf	946-026795-224
	Polystyrene 10% 50V	
	.1 uf	946-026037-104
	.15 uf	946-026037-154
	.012 uf	946-026037-123
	.015 uf	946-026037-153
	.0015 uf	946-026037-152
	.018 uf	946-026037-183
	.01 uf	946-026037-103
	.001 uf	946-026037-102
	.022 uf	946-026037-223
	.0022 uf	946-026037-222
	.027 uf	946-026037-273
	.033 uf	946-026037-333
	.0033 uf	946-026037-332
	.039 uf	946-026037-393
	.047 uf	946-026037-473
	.0047 uf	946-026037-472
	.056 uf	946-026037-563
	.0056 uf	946-026037-562
	.068 uf	946-026037-683
	.0068 uf	946-026037-682
	.082 uf	946-026037-823
	.0082 uf	946-026037-822
Diodes		
All		919-024769
Integrated Circuits		
IC1-3	Quad Op-Amp	991-022794
Socket	14-Pin	906-018905
Transistors		
Q1-28		991-018238
Q29-32		991-028269
Q33, 34		991-026315
Q35-37		991-028269
Q38		991-010098
Q39		991-028269
Q40		991-010098

BOARD F
Upper Flute & String Collectors

Capacitors	**Electrolytic**	
	10 uf 16V	945-026783-004
C1	470 uf 16V	945-026783-011
C7	100 uf 16V	945-026783-006
C14	470 uf 16V	945-026783-011
	1 uf 50V	945-026783-014
	2.2 uf 16V	945-028285-002
	Metal Polyester 5% 50V	
	.1 uf	946-026745-104
	.012 uf	946-026745-123
	.015 uf	946-026745-153
	.0015 uf	946-026745-152
	.018 uf	946-026745-183
	.01 uf	946-026745-103
	.022 uf	946-026745-223
	.027 uf	946-026745-273
	.0022 uf	946-026745-222
	.033 uf	946-026745-333
	.0033 uf	946-026745-332
	.039 uf	946-026745-393
	.0039 uf	946-026745-392
	.047 uf	946-026745-473
	.0047 uf	946-026745-472
	.0056 uf	946-026745-562
	.056 uf	946-026745-563
	.068 uf	946-026745-683
	.0068 uf	946-026745-682
	.0082 uf	946-026745-822
	Metal Polyester 20% 50V	
	.1 uf	946-026795-104
	.22 uf	946-026795-224
	.0068 uf	946-026795-682
	.033 uf	946-026795-333
	.0033 uf	946-026795-332
	.047 uf	946-026795-473
	Polystyrene 10% 50V	
	.012 uf	946-026037-123
	.01 uf	946-026037-103
	.018 uf	946-026037-183
	.0015 uf	946-026037-152
	.0018 uf	946-026037-182
	.001 uf	946-026037-102
	.027 uf	946-026037-273
	.0022 uf	946-026037-222
	.0027 uf	946-026037-272
	.0033 uf	946-026037-332
	.0039 uf	946-026037-392

PARTS LIST

BOARD F
Upper Flute & String Collectors (Continued)

Capacitors	Polystyrene 10% 50V	
	.0047 uf	946-026037-472
	.0056 uf	946-026037-562
	.0068 uf	946-026037-682
	.0082 uf	946-026037-822
	.015 uf	946-026037-153
	.039 uf	946-026037-393
Diodes		
All		919-024769
Integrated Circuits		
IC1, 2	Quad Op-Amp	991-022794
Photocell		
P1		948-022782
Sockets	14-Pin	906-018905
Transistors		
Q1-21		991-018238
Q22-30		991-028269
Q31-35		991-018238
Q36		991-026315
Q37		991-028269
Q38		991-010098

BOARD G
Lighted Button Logic

Capacitors	Electrolytic	
C1	100 uf 16V	945-026783-006
	Metal Polyester 20% 50V	
	.0015 uf	946-026795-152
	.022 uf	946-026795-223
	.27 uf	946-026795-274
Diodes		
All		919-024769
Integrated Circuits		
IC1	Quad NOR	991-026025
IC2	Hex Inverter	991-027359
IC3	Quad NOR	991-026025
IC4	Hex Inverter	991-027359
IC5, 6	Quad NOR	991-026025
IC7	Hex Inverter	991-027359
IC8	Quad NOR	991-026025
IC9	Hex Inverter	991-027359
IC10	Quad NOR	991-026025
IC11	Hex Inverter	991-027359
IC12-14	Quad NOR	991-026025
IC15	Quad NAND	991-025515

BOARD G
Lighted Button Logic (Continued)

Resistors	WW 10%	
	22 ohm 2W	924-010471-220
Sockets	14-Pin	906-018905
Transistors		
Q1-30		991-016727
Q31		991-002232
Q32		991-016727
Q33		991-010098
Q34		991-002232
Q35		991-016727
Q36		991-010098
Q37		991-020425-001
Q38		991-002232
Q39		991-026315

BOARD H
Upper/Lower Reed/String QC

Capacitors	Electrolytic	
	2.2 uf 25V	945-026783-001
C1-3	100 uf 16V	945-026783-006
	2.2 uf 16V	945-028285-002
	3.3 uf 16V	945-028285-001
	Polystyrene 10% 50V	
	.001 uf	946-026037-102
	.01 uf	946-026037-103
	.1 uf	946-026037-104
	.012 uf	946-026037-123
	.0015 uf	946-026037-152
	.015 uf	946-026037-153
	.0022 uf	946-026037-222
	.022 uf	946-026037-223
	.22 uf	946-026037-224
	.0033 uf	946-026037-332
	.033 uf	946-026037-333
	.039 uf	946-026037-393
	.0047 uf	946-026037-472
	.047 uf	946-026037-473
	.47 uf	946-026037-474
	.056 uf	946-026037-563
	.0068 uf	946-026037-682
Integrated Circuits		
IC1-3	Op-Amp	991-021444-001
IC4	Quad Op-Amp	991-025267
IC5	Op-Amp	991-021444-001
Potentiometers	50K 20%	
VR1, 2		925-004349-007

PARTS LIST

BOARD H
Upper/Lower Reed/String QC (Continued)

Sockets	8-Pin	906-021448
	14-Pin	906-018905
Transistors		
Q1, 2		991-026617
Q3, 4		991-028269
Q5		991-018238
Q6, 7		991-028269
Q8		991-026617
Q9, 10		991-028269
Q11		991-026617
Q12, 13		991-028269
Q14		991-018238
Q15, 16		991-028269
Q17		991-010098
Q18		991-026617
Q19		991-028269
Q20		991-018238
Q21, 22		991-028269
Q23		991-026617
Q24		991-028269
Q25		991-018238
Q26, 27		991-026315-002
Q28		991-018238
Q29, 30		991-028269
Q31		991-018238
Q32		991-028269
Q33		991-010098
Q34, 37		991-026617

BOARD J
DC Control

Capacitors	Electrolytic	
	10 uf 16V	945-026783-004
C1, 2	100 uf 16V	945-026783-006
	Polystyrene 10% 50V	
	.15 uf	946-026037-154
	.22 uf	946-026037-224
	.33 uf	946-026037-334
	.047 uf	946-026037-473
	.56 uf	946-026037-564
	.082 uf	946-026037-823
	.068 uf	946-026037-683
	Tantalum 20% 35V	
	10 uf	946-021452-005
	2.2 uf	946-012624-225
Diodes		
Z1	Zener 10V	919-017406-057
All others		919-024769

BOARD J
DC Control (Continued)

Integrated Circuits		
IC1	Dual Op-Amp	991-025244
IC2, 3	Quad NOR	991-026025-002
Potentiometers		
VR1	50K 20%	925-004349-007
VR2	10K 20%	925-004349-003
Sockets	14-Pin	906-018905
	8-Pin	906-021448
Transistors		
Q1,3,4		991-026315
Q5		991-013544
Q6		991-026617
Q7		991-026315
Q8		991-026617
Q9-12		991-026315
Q13		991-010098
Q14, 15		991-026315
Q16, 18		991-010098
Q19		991-026315
Q20		991-026617
Q21-Q25		991-026315
Q28		991-020425-001
Q29		991-026315-002
Q31-33		991-026315

BOARD K
Output Mixer

Capacitors	Electrolytic	
C1,2,5,6	100 uf 16V	945-026783-006
	4.7 uf 35V	945-026783-003
	2.2 uf 16V	945-028285-002
	Metal Polyester 20% 50V	
	.01 uf	946-026795-103
	.1 uf	946-026795-104
	.15 uf	946-026795-154
	.22 uf	946-026795-224
	.047 uf	946-026795-473
	.47 uf	946-026795-474
	.0068 uf	946-026795-682
	.033 uf	946-026795-333
Diodes		
D4	Triple	919-010454-001
All others		919-024769

PARTS LIST

BOARD K
Output Mixer (Continued)

Integrated Circuits			
	IC1	Op-Amp	991-021444-001
	IC2	Quad Op-Amp	991-022794
	IC3, 4	Op-Amp	991-021444-001
	IC5	Quad Op-Amp	991-022794
	IC6,7	Op-Amp	991-021444-001
Sockets		8-Pin	906-021448
		14-Pin	906-018905
		16-Pin	906-018905-001
Transistors			
	Q1		991-028269
	Q3		991-026617
	Q4		991-026315-002
	Q5		991-026617
	Q6-8		991-026315-002
	Q9		991-026617
	Q10		991-028269
	Q11,12		991-026617

BOARD L
Flute & String Chorus Modulator

Capacitors		Electrolytic	
		10 uf 16V	945-026783-004
	C2,3	100 uf 16V	945-026783-006
	C5	470 uf 16V	945-026783-011
		Metal Polyester 5% 50V	
		.1 uf	946-026745-104
		.012 uf	946-026745-123
		.12 uf	946-026745-124
		.18 uf	946-026745-184
		.0022 uf	946-026745-222
		.022 uf	946-026745-223
		.27 uf	946-026745-274
		.0056 uf	946-026745-562
		.68 uf	946-026745-684
		.082 uf	946-026745-823
		.022 uf	946-026795-223
		.47 uf	946-026795-474
		.082 uf	946-026795-823
Diodes			
	All		919-024769
Integrated Circuits			
	IC1	Hex Inverter	991-027359
	IC2-4	Quad Op-Amp	991-025267
	IC5,6	Dual J-K Flip Flop	991-026022
	IC7-9	Bucket Brigade	991-028690

BOARD L
Flute & String Chorus Modulator (Continued)

Sockets		16-Pin	906-018905-001
		14-Pin	906-018905
		8-Pin	906-021448
Transistors			
	Q2-4		991-016727
	Q5,6		991-028691
	Q7,8		991-026315
	Q9,10		991-028691
	Q11,12		991-026315
	Q13,14		991-028691
	Q15,16		991-026315

BOARD M
Reed Chorus

Capacitors		Electrolytic	
	C1,3,4,5	100 uf 16V	945-026783-006
		2.2 uf 16V	945-028285-002
		220 uf 15V	945-026783-012
		Metal Polyester	
		.0022 uf 5% 50V	946-026745-222
		.001 uf 5% 50V	946-026745-102
		.82 uf 20% 50V	946-026795-824
		Polystyrene 10% 50V	
		.22 uf	946-026037-224
		.047 uf	946-026037-473
		.0068 uf	946-026037-682
		.033 uf	946-026037-333
Diodes			
	All		919-024769
Integrated Circuits			
	IC1	Bucket Brigade	991-020077-002
	IC2,3	Dual Op-Amp	991-025244
Potentiometers			
	VR1	100K 20%	925-004349-010
	VR2	25K 20%	925-004349-006
Sockets		16-Pin	906-018905-001
		8-Pin	906-021448
Transistors			
	Q1,2		991-028691

BOARD N
Solo Keyers & Filters

Capacitors		Electrolytic	
		10 uf 16V	945-026783-004

PARTS LIST

BOARD N
Solo Keyers & Filters (Continued)

Capacitors	Electrolytic	
C1,6,7,10	100 uf 16V	945-026783-006
	2.2 uf 16V.	945-028285-002

Metal Polyester 5% 50V	
.12 uf	946-026745-124
.001 uf	946-026745-102
.0015 uf	946-026745-152
.15 uf	946-026745-154
.018 uf	946-026745-183
.0022 uf	946-026745-222
.027 uf	946-026745-273
.22 uf	946-026745-224
.33 uf	946-026745-334
.01 uf	946-026745-103
.0047 uf	946-026745-472
.015 uf	946-026745-513
.056 uf	946-026745-563
.0068 uf	946-026745-682
.068 uf	946-026745-683
.0082 uf	946-026745-822

Polystyrene 10% 50V	
.001 uf	946-026037-102
.01 uf	946-026037-103
.1 uf	946-026037-104
.015 uf	946-026037-153
.0022 uf	946-026037-222
.22 uf	946-026037-224
.27 uf	946-026037-274
.0033 uf	946-026037-332
.033 uf	946-026037-333
.33 uf	946-026037-334
.0056 uf	946-026037-562
.0068 uf	946-026037-682
.068 uf	946-026037-683
.0082 uf	946-026037-822
.082 uf	946-026037-823
.0027 uf	946-026037-272
.027 uf	946-026037-273
.15 uf	946-026037-154

Tantalum 20% 35V	
.47 uf	946-012624-474
.68 uf	946-012624-684

Diodes	
D1,3,9,10,18,25,37	919-004799
All others	919-024769

Integrated Circuits		
IC1-3	Hex Inverter	991-027359-002
IC4	Quad Analog Switch	991-028679-001

BOARD N
Solo Keyers & Filters (Continued)

Integrated Circuits		
IC6-9	Quad Analog Switch	991-028679-001
IC10,11	Op-Amp	991-021444-001
IC12	Quad Op-Amp	991-025267
IC13	Dual Op-Amp	991-025244
IC14	Lin. Comparator	991-028688

Sockets		
	14-Pin	906-018905
	8-Pin	906-021448

Transistors	
Q1,2	991-026315
Q3	991-018238
Q4	991-026315
Q5-10	991-016727
Q11-13	991-026315
Q14	991-025535
Q15-17	991-026315
Q18,19	991-010098
Q20-24	991-018238
Q25	991-010098
Q26	991-018238
Q27	991-010098
Q28	991-018238
Q29	991-010098
Q30	991-018238

BOARD P
Rhythm Logic

Capacitors	Electrolytic	
C1	100 uf 16V	945-026783-006
	2.2 uf 25V	945-026783-001
	1 uf 50V	945-026783-014
C8	4.7 uf 16V	945-026783-002
C14	10 uf 16V	945-026783-004

Polystyrene 10% 50V	
.33 uf	946-026037-334
.047 uf	946-026037-473
.068 uf	946-026037-683
.033 uf	946-026037-333
.01 uf	946-026037-103
.001 uf	946-026037-102
.15 uf 50V	946-026037-154
.22 uf 50V	946-026037-224
.022 uf	946-026037-223
.027 uf	946-026037-273

Diodes		
Z1	Zener 3.3V	919-017406-018
Z2,3	Zener 10V	919-017406-057
All others		919-024769

PARTS LIST

BOARD P
Rhythm Logic (Continued)

Integrated Circuits

IC1	ROM 1	920-028662
IC2	Hex D Flip-Flop	991-028685-001
IC3	Dual 4-Bit Shift Register	991-026609
IC4	Phase Locked Loop	991-028683-001
IC5	Quad NOR	991-026025
IC6	Quad OR	991-025516
IC7	Quad AND	991-025517
IC8	Hex Buffer	991-028686
IC9	Bass Note Select	991-028689-001
IC10	TOS	991-027326
IC11	Dual Flip Flop	991-027358-001
IC12	Dual AND/OR Invert	991-026613
IC13	Quad AND	991-025517
IC14	ROM 2	920-028675
IC15	Priority Encoder	991-025599
IC16	Triple 3 Input AND	991-028684-001
IC17	Dual AND/OR Invert	991-026613
IC18	Quad AND/OR	991-028680-001
IC19	Hex Inverter	991-027359
IC20	Quad NOR	991-026025
IC21	Hex Inverter	991-027359
IC22	Quad AND	991-025517
IC23	Dual Flip Flop	991-027358-001
IC24	Quad OR	991-025516
IC25	Hex Inverter	991-027359
IC26	Quad NAND	991-025515
IC27	RFG	920-028273
IC28	Quad AND	991-025517
IC29	Dual Flip Flop	991-027358-001

Sockets	28-Pin	906-018905-003
	24-Pin	906-018905-002
	16-Pin	906-018905-001
	14-Pin	906-018905

Transistors

Q1	991-010098
Q2	991-016727
Q3,5	991-010098
Q6	991-013544
Q7,8	991-026617
Q9-11	991-026315-002
Q12-22	991-026315
Q23-29	991-010098

BOARD R
CFG & Pedal

Capacitors	Electrolytic	
C3	100 uf 16V	945-026783-006

Capacitors	Metal Polyester 20% 50V	
	.001 uf	946-026795-102
	.1 uf	946-026795-104
	.01 uf	946-026795-103
	.047 uf	946-026795-473
	.0047 uf	946-026795-472
	.022 uf	946-026795-223

Coils

L1	Oscillator	952-018874-004
L2	Oscillator	952-018874-003

Diodes

D7,43	919-024117
All others	919-024769

Integrated Circuits

IC1	Scan Comparator	991-028687-001
IC2	Keydown Latch	991-028685-001
IC3	Triple 3 Input OR	991-026006
IC4	'Y' Selector	991-028689-001
IC5	Pedal Latch	920-028630
IC6	33-Bit Converter	991-022793
IC7	Hex Inverter	991-027359
IC8	Dual J-K Flip Flop	991-026022
IC9	Triple 3 Input NOR	991-028682-001
IC10	Dual AND/OR Inverter	991-026613
IC11	Hex Inverter	991-027359
IC12	Quad NAND	991-025515
IC13	Quad AND	991-025517
IC14	Hex Buffer	991-028650-001
IC15	CFG	991-026003-002
IC16-18	Dual Flip Flop	991-027358
IC19	Solo Generator	920-025507
IC20	Hex Buffer	991-028650-001
IC21-23	Dual Flip Flop	991-027358
IC24,25	Quad OR	991-025516
IC26	Hex Inverter	991-027359

Potentiometer

VR1	10K 20%	925-004349-003

Sockets	40-Pin	906-022727
	24-Pin	906-018905-002
	16-Pin	906-018905-001
	14-Pin	906-018905

Transistor

Q1	991-018238

PARTS LIST

BOARD S
Instrumentation

Capacitors	Electrolytic	
	2.2 uf 16V	945-028285-002
	1 uf 50V	945-026783-014
	2.2 uf 25V	945-026783-001
	4.7 uf 16V	945-026783-002
C1,5,10, 11	100 uf 16V	945-026783-006
	2 uf 20V	945-008895-032
	Metal Polyester 5% 50V	
	.082 uf	946-026745-823
	.0056 uf	946-026745-562
	.47 uf	946-026745-474
	.047 uf	946-026745-473
	.0039 uf	946-026745-392
	.33 uf	946-026745-334
	.1 uf	946-026745-104
	.0015 uf	946-026745-152
	.001 uf	946-026745-102
	.012 uf	946-026745-123
	.0018 uf	946-026745-182
	.18 uf	946-026745-184
	.0022 uf	946-026745-222
	.0027 uf	946-026745-272
	.0033 uf	946-026745-332
	.033 uf	946-026745-333
	.068 uf	946-026745-683
	Metal Polyester 10% 50V	
	.01 uf	946-026037-103
	Metal Polyester 20% 50V	
	.1 uf	946-026795-104
	.01 uf	946-026795-103
	.001 uf	946-026795-102
	.012 uf	946-026795-123
	.12 uf	946-026795-124
	.015 uf	946-026795-153
	.0022 uf	946-026795-222
	.022 uf	946-026795-223
	.22 uf	946-026795-224
	.027 uf	946-026795-273
	.033 uf	946-026795-333
	.047 uf	946-026795-473
	.47 uf	946-026795-474
	.27 uf	946-026795-274
	.082 uf	946-026795-823

BOARD S
Instrumentation (Continued)

Capacitors	Metal Polypropylene 5% 50V	
	.12 uf	946-026784-124
	.033 uf	946-026784-333
	.039 uf	946-026784-393
	.068 uf	946-026784-683
	.1 uf	946-026784-104
	Polypropylene 2.5% 50V	
	.01 uf	946-027302-103
	.0051 uf	946-027302-512
Diodes		
D45-48		919-010873
All others		919-024769
Integrated Circuits		
IC1-6	Quad Op-Amp	991-022794
IC7-9	Dual Flip-Flop	991-027358-001
IC10	Noise Generator	991-024108
IC11	TOS	991-027326
Sockets	16-Pin	906-018905-001
	14-Pin	906-018905
	8-Pin	906-021448
Transistors		
Q2		991-026315-002
Q4		991-028269
Q5		991-018238
Q6		991-028269
Q7		991-018238
Q8		991-028269
Q9,10		991-026315-002
Q11,12		991-018238
Q13,14		991-026315-002
Q15,16		991-018238
Q17		991-026315-002
Q18,19		991-018238
Q20		991-026315-002
Q21		991-026617
Q22		991-026315-002
Q23		991-018238
Q24-26		991-026617
Q27,28		991-026315-002
Q29,30		991-026617
Q31-34		991-026315-002
Q35,36		991-018238

PARTS LIST

BOARD T
Amplifier

Capacitors	Electrolytic	
	2.2 uf 63V	945-026783-017
	417 uf 63V	945-026783-018
	10 uf 100V	945-026783-020
	22 uf 63V	945-026783-019
Diodes		
D1,2		919-024769
Fuse	3-Amp Fast-Blo	939-001197-003
Transistors		
Q1,2		991-026617
Q3		991-015614
Q4		991-013544
Q10		991-026617

BOARD V
Crossover

Capacitors	Electrolytic	
	10 uf 25V	945-026783-010
C1,2	100 uf 16V	945-026783-006
	3.3 uf 16V	945-028285-001
	Metal Polyester 5% 50V	
	.01 uf	946-026745-103
	.068 uf	946-026745-683
	.082 uf	946-026745-823
	Polystyrene 10% 50V	
	.082 uf	946-026037-823
Diodes		
D1		919-024769
D2,3		919-004799
Integrated Circuit		
IC2	Dual Op-Amp	991-025244
Potentiometers		
VR1	25K 20%	925-004349-006
VR2	500K 20%	925-004349-008
Relays		
RL1	4-PDT	921-024167
RL2	2-PDT	921-029096
Resistors	WW 10%	
	150 ohm 2W	924-010471-151
	47 ohm 2W	924-010471-470
Socket	8-Pin	906-021448

BOARD V
Crossover (Continued)

Transistors		
Q12		991-026617
Q13-15		991-026315-002
Q16		991-026617
Q17		991-026315-002
Q19		991-026315-002
Q21		991-016727

BOARD W
Regulator

Capacitors	Electrolytic	
C1	100 uf 16V	945-026783-006
C2,3	22 uf 25V	945-026783-005
Diode		
Z1	Zener 15V	919-026799-068
Integrated Circuit		
IC3	Neg. 15V Reg.	992-026646-009
Photocell		
P1	Leslie Speed Control	948-026647-001
Resistors	WW 10%	
R1	5 ohm 5W	924-008896-046
Triac	Leslie Speed Control	992-028661

BASS PEDAL ASSEMBLY

Assemblies	Long Pedal	997-006405
	Short Pedal	997-006406
Caps	Black	915-003863
	Dark Brown	915-003856
Springs	Compression	975-005811
	Contact	917-009155
	Buss Bar	918-002342
	Contact Buss	918-009995

BENCH ASSEMBLY

Bench	Walnut	978-028604

CONSOLE ASSEMBLY

Back		972-029200

PARTS LIST

CONSOLE ASSEMBLY (Continued)

Endblocks	Lower LH......	978-028632-001
	Lower RH......	978-028633-001
	Upper LH......	978-028634-001
	Upper RH......	978-028635-001
Lamp	Bass Pedal GE70.	939-026038-004
Lens	Bass Pedal......	922-029251
Rail	Upstop........	936-028268-004
Socket	Aux. Input/Output	997-029603
	Bass Pedal Lamp.	906-029256
Spring	Reverb Unit....	984-017447
Speakers		
Bass	10-inch 8 ohm	985-024183
Chorus 2,3	6x9-inch 8 ohm	985-009960-002
Main	8-inch 8 ohm .	985-003185-004

LESLIE TREMOLO UNIT

Assembly	Leslie Unit Complete....	984-028625
Assembly	Motor Bracket ..	484-140609
Bracket	Motor	484-140608-031
Bracket	Rubber Bushing .	484-137536
Assembly	Rotor & Shaft ..	484-138027
Assembly	Shaft & Pulley ..	484-138003
Foam	Rotor.........	484-138027
Assembly	Motor 117V 60Hz	484-140440
Motor (only)	117V 60Hz....	484-140647
Pulley	60Hz..........	484-138420
Pulley	50Hz..........	484-014191
Bearing	....	484-137264
Belt	....	484-045468
Grommet	Neoprene......	484-137255
Speaker	10-inch........	484-017202
Support	Rotor, Hub	484-137533
Support	Rotor, Steel Rod	484-138198

POWER SUPPLY CHASSIS

Arm	Actuator.......	967-026076
Assemblies	**Control Arm**	
	Expression Pedal/ Glide Switch..	997-029491
	Glide Switch....	997-029492
	Pedal & Mat....	997-023127
	Power Supply...	997-028870
Bulb	GE1819	939-003190
Capacitors	**Electrolytic**	
	2200 uf 63V....	945-026797-004
	2200 uf 35V....	945-026797-006
Clip	Fuse..........	976-026063
Cord	Power.........	989-008717
Diffuser	Clear..........	922-015938
Diodes		
D1	Bridge Rectifier 6-Amp	919-022736-003
D2	Bridge Rectifier 30-Amp	919-029090
Fuses	1-Amp Slo-Blo Pigtail.......	939-001120-002
	5-Amp Slo-Blo Pigtail.......	939-001120
Light	Shield.........	922-026077
Mats	Expression Pedal	959-022953
	Glide/Minor....	959-009208-003
	Glide/Minor....	959-009208-004
Photocell	Expression Pedal	948-029970
Resistors	**WW 10%**	
	1 ohm 2W......	924-008896-047
	1500 ohm 5W ..	924-008896-014
	5 ohm 5W......	924-008896-046
	.18 ohm 2W....	924-008896-021
	.18 ohm 5W....	924-008896-029

PARTS LIST

POWER SUPPLY CHASSIS (Continued)

Springs	Glide Switch. . . .	975-022949
	Compression. . . .	975-011747-001
	Contact Glide/ Minor	917-027316
	Contact	917-029542
Transformers		
T1	Power 120V	954-029548
T2	Power 120V	954-029091
Transistors		
Q5	. . . .	992-026039-002
Q6	. . . .	992-026040-002
Q9	. . . .	991-026315-002

TAB PANEL ASSEMBLY

Assembly	Mechanical Tabswitch. . . .	997-028886
Clip	Lamp Retainer	976-028699
Guide	Slider	976-005170-001
Jack	Headphone.	910-028601
Knobs	Blue Variegated .	915-026335-003
	Gray Variegated .	915-026335-006
	Green Variegated	915-026335-005
	Red Variegated .	915-026335-002
	Yellow Variegated	915-026335-004
Lamps	Tab Panel, Lighted Presets GE73 .	939-026038-002
Lens	**Pushbutton**	
	Black	922-027397
	Blue	922-027397-006
	Clear	922-027397-010
	Green	922-027397-005
	Red	922-027397-002
	White	922-027397-009
	Yellow	922-027397-004

Potentiometers (20% unless otherwise specified)

Lower Strings	10K Log	925-028620-003
Magic Melody	Dual 10K Log	925-028600-001
Reverb Length	10K Log.	925-028620-003

TAB PANEL ASSEMBLY (Continued)

Rhythm Balance	Dual 10K Lin	925-028600-002
Rhythm Speed	1Meg Log 25%	925-028620-006
Rhythm Volume	Dual 10K Lin	925-028600-002
Solo Tuning	25K Lin	925-028620-001
Solo Vibrato Depth	10K Lin .	925-028620-002
Solo Vibrato Speed	100K Log.	925-028620-005
Solo Volume	10K Log.	925-028620-003
Sustain Organ	10K Lin.	925-028620-002
Upper Strings	10K Log.	925-028620-003
Wow Attack	100K Lin.	925-028620-004
Wow Range	10K Lin.	925-028620-002

Pusher	Medium	964-025555
Resistor	WW 10% 150 ohm 2W. . . .	924-010471-151
Sockets	Lamp	906-028617
Springs	Contact.	917-005166-004
	Toggle	975-025543
Switches	Pushbutton.	960-027396
	Power 120V	960-028213
	Track Select	960-027322
Tabs	AOC.	915-025544-005
	Banjo	915-025544-014
	Bass Full	915-025544-048
	Bass Medium	915-025544-049
	Clarinet 16	915-025544-091
	Cornet 16.	915-025544-110
	Flute 1	915-025544-069
	Flute 2	915-025544-034
	Flute 2-2/3.	915-025544-035
	Flute 4	915-025544-036
	Flute 8	915-025544-038
	Flute 16	915-025544-039
	Flute Chorus . . .	915-025544-072
	Flute String Celeste	915-025544-113
	Genie String Bass	915-025544-051
	Guitar.	915-025544-045
	Guitar Bass.	915-025544-116
	Kinura 8.	915-025544-040
	Leslie Trem Flute	915-025544-114
	Lower Full	915-025544-090
	Lower Medium. .	915-025544-093
	Magic Melody Banjo	915-025544-109

PARTS LIST

TAB PANEL ASSEMBLY (Continued)

Tabs	Magic Genie Chords	915-025544-032
	Magic Melody Piano	915-025544-099
	Magic Melody Strings	915-025544-115
	Magic Swing Bass	915-025544-107
	Main Celeste	915-025544-112
	Main Chorus	915-025544-111
	Pedal 16/8	915-025544-098
	Pedal Sustain	915-025544-057
	Piano	915-025544-017
	Repeat	915-025544-061
	Rhythm 1	915-025544-084
	Rhythm 2	915-025544-085
	Rhythm 3	915-025544-086
	Rhythm 4	915-025544-087
	Rhythm 5	915-025544-088
	Rhythm 6	915-025544-089
	Rhythm Start Auto	915-025544-047
	Trombone 16	915-025544-042
	Vibrato	915-025544-006

UPPER/LOWER KEYSWITCH ASSEMBLY

Actuators	Lower Keyswitch	964-026765
	Upper Keyswitch	964-024116-001
Clip	Spring	976-009364-002
Coil	70MH	956-018877
Diodes All		919-010873
Keys	Black	964-024757
	White A	964-028228-001
	White B	964-028228-002
	White C	964-028228-003
	White D	964-028228-004
	White E	964-028228-005
	White F	964-028228-006
	White G	964-028228-007
	White A1 Lower Keyboard	964-028228-008
	White C4 Upper Keyboard	964-028228-009
Springs	Pulldown	975-028222
	Contact	917-015558
Wire	Keyswitch Actuator	976-026764

NOTE: Keys are supplied without wire actuators. Insert wire actuator from original key into replacement key. If new actuators are needed, they should be ordered separately.

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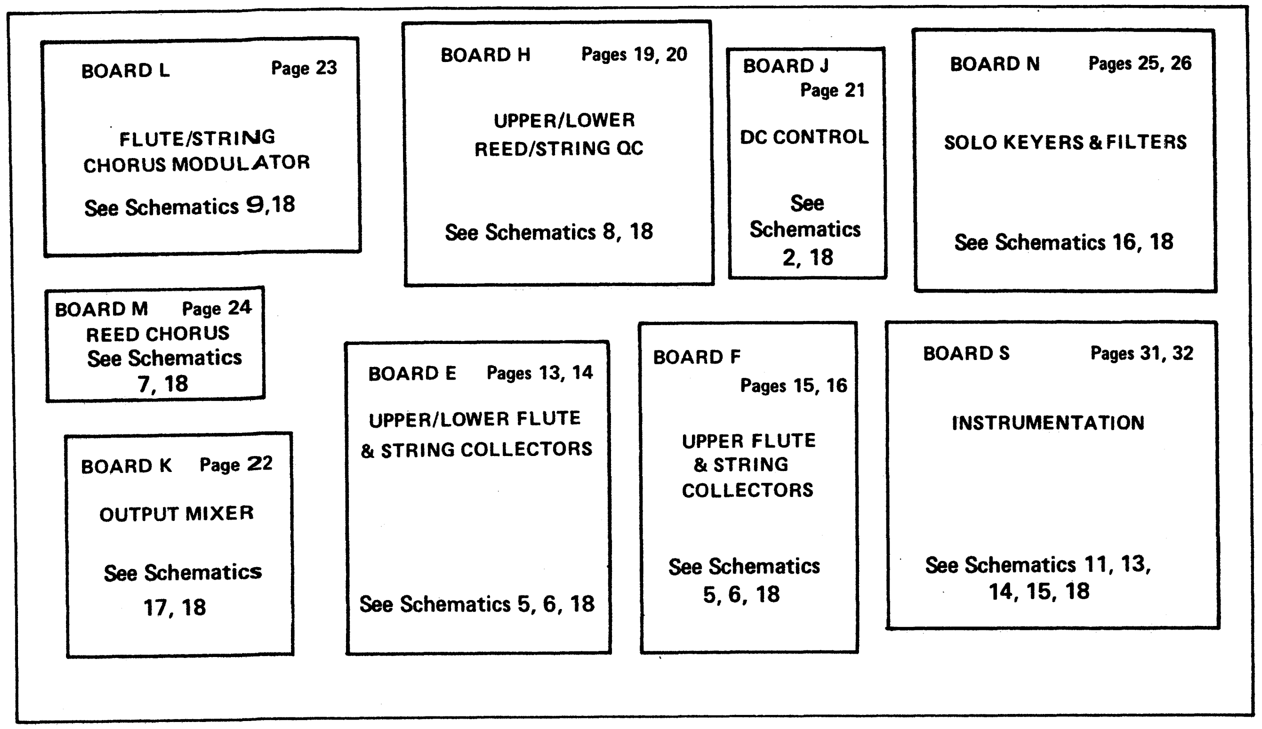
BOARD L Page 23
FLUTE/STRING CHORUS MODULATOR
See Schematics 9,18
BOARD H Pages 19, 20
UPPER/LOWER REED/STRING QC
See Schematics 8, 18
BOARD J Page 21
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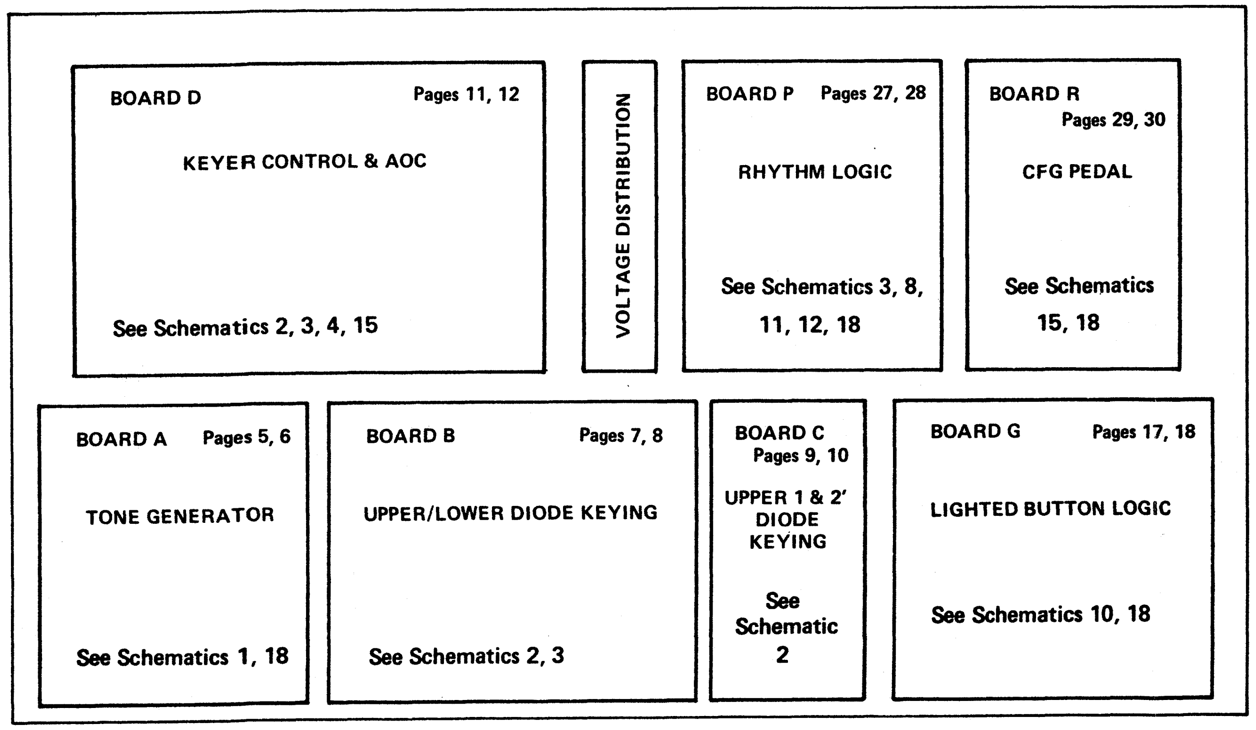
UPPER FLUTE & STRING COLLECTORS
See Schematics 5, 6, 18
BOARD S Pages 31, 32
INSTRUMENTATION
See Schematics 11, 13, 14, 15, 18

TRAY UP

D325 BOARD LOCATION

TRAY DOWN


BOARD D Pages 11, 12
KEYER CONTROL & AOC
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TONE GENERATOR
See Schematics 1, 18
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UPPER 1 & 2' DIODE KEYING
See Schematic 2
BOARD G Pages 17, 18
LIGHTED BUTTON LOGIC
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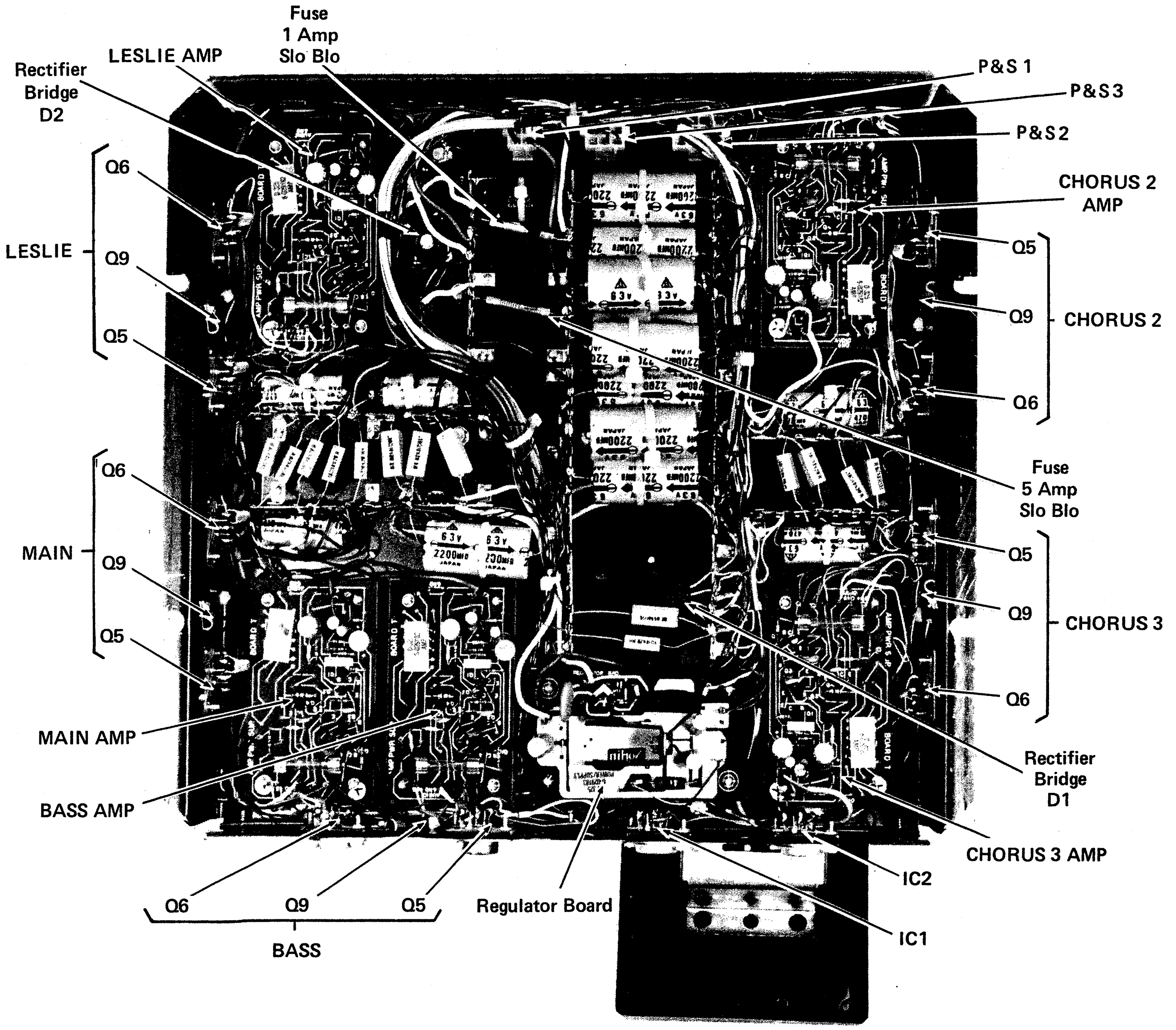
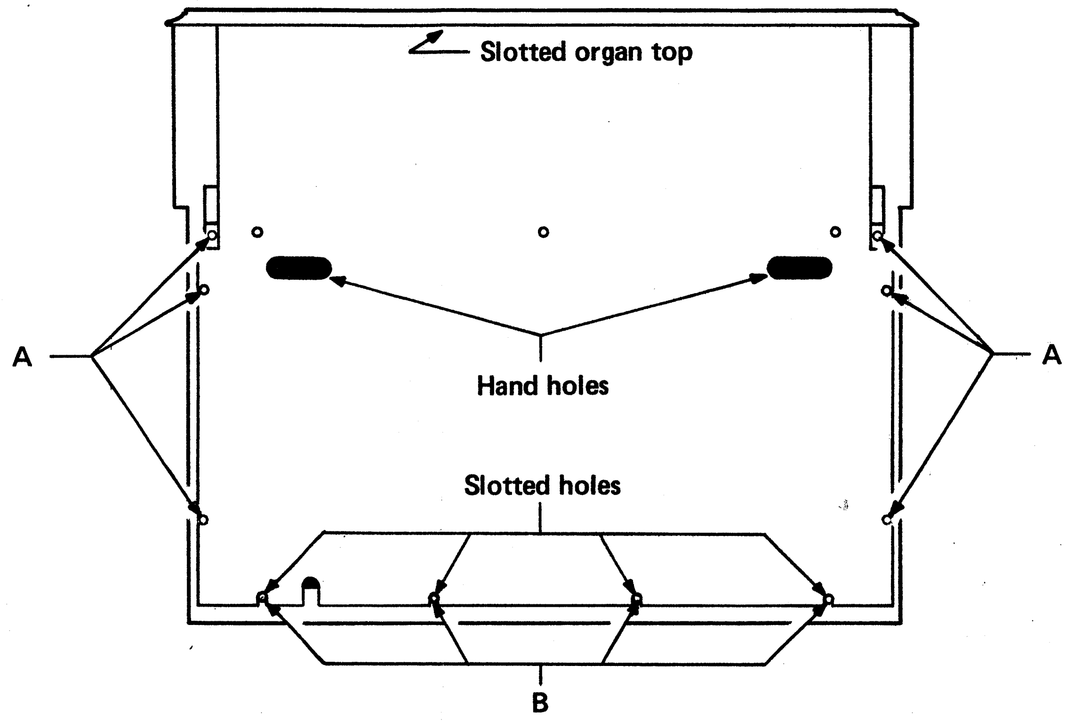
BOARD T, Page 33 – AMPLIFIERS – See Schematics 18, 19 } Located in Power Supply Chassis
BOARD W, Page 35 – REGULATOR – See Schematic 18 }
BOARD V, Page 34 – CROSSOVER – See Schematics 17, 18, 19 – – – Located on Top of Power Supply Chassis

POWER SUPPLY CHASSIS
(Bottom View)


Fuse
1 Amp
Slo Blo
Rectifier Bridge D2
LESLIE AMP
P&S 1
P&S3
P&S2
CHORUS 2 AMP
LESLIE
Q6
Q9
Q5
Q5
Q9
Q6
CHORUS 2
MAIN
Q6
Q9
Q5
Fuse
5 Amp
Slo Blo
Q5
Q9
Q6
CHORUS 3
MAIN AMP
BASS AMP
Rectifier Bridge D1
CHORUS 3 AMP
IC2
IC1
Q6
Q9
Q5
BASS
Regulator Board

BACK OF ORGAN


Slotted organ top
A
A
Hand holes
Slotted holes
B

To remove back:

1. Remove screws marked A.
2. Loosen screws marked B.
3. Grip organ back through hand holes and pull toward you until top of organ back is removed from slot in top of organ.
4. Raise organ back until slotted holes at bottom of organ back are clear of screws.

To replace back:

1. Slide slotted holes at bottom of organ back over screws marked B.
2. With hands in hand holes, bend top of organ back forward and insert it in slotted organ top.
3. Replace screws marked A. Tighten screws marked B.

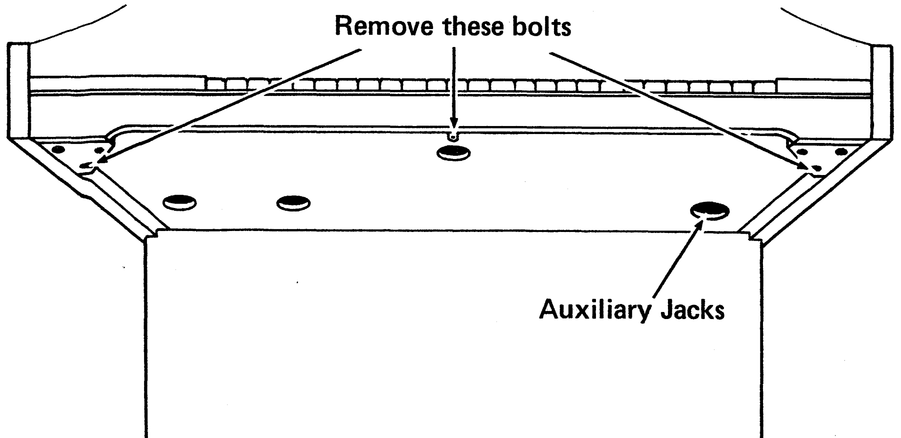

Remove these bolts
Auxiliary Jacks

FIGURE 1

TRAY ASSEMBLY REMOVAL

1) Remove organ back.
2) Unfasten any cables that are attached to inside of cabinet walls (i.e. power supply cables).
3) Remove bolts located under front keybed (see Figure 1).
4) Remove two bolts from brackets on left and right sides of circuit board tray (Figure 2).
5) Slide tray assembly toward rear of organ.

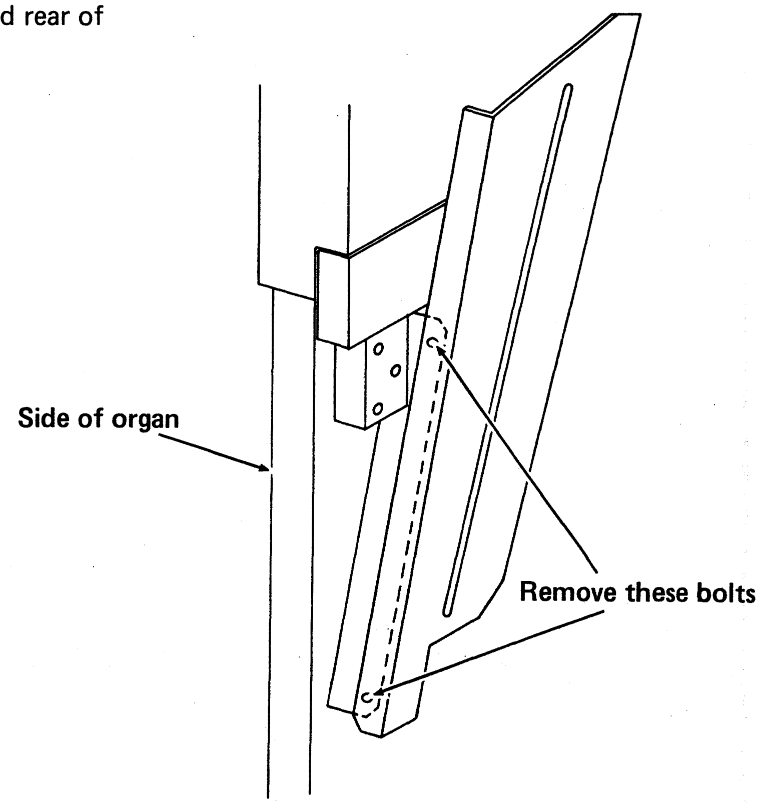
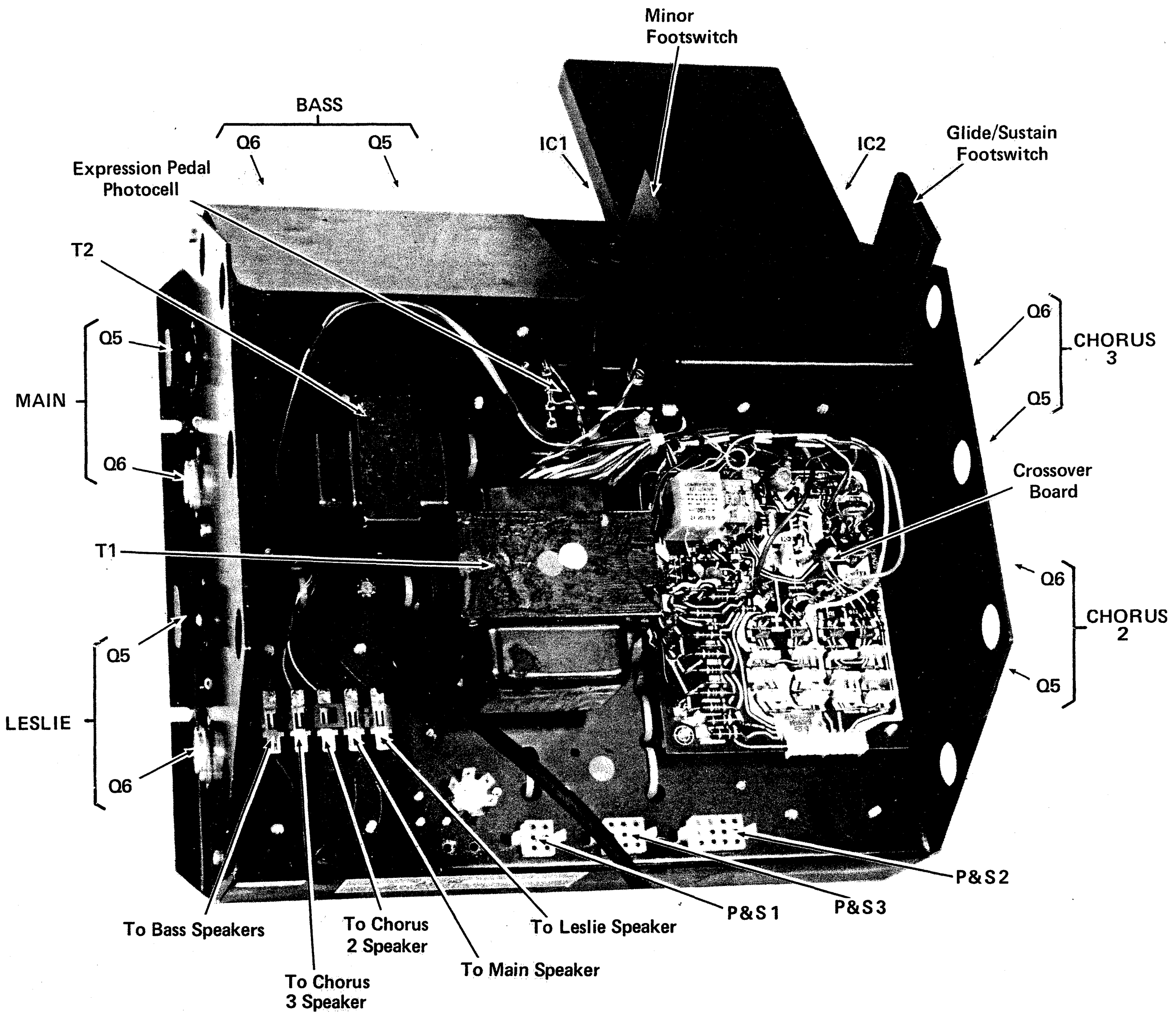
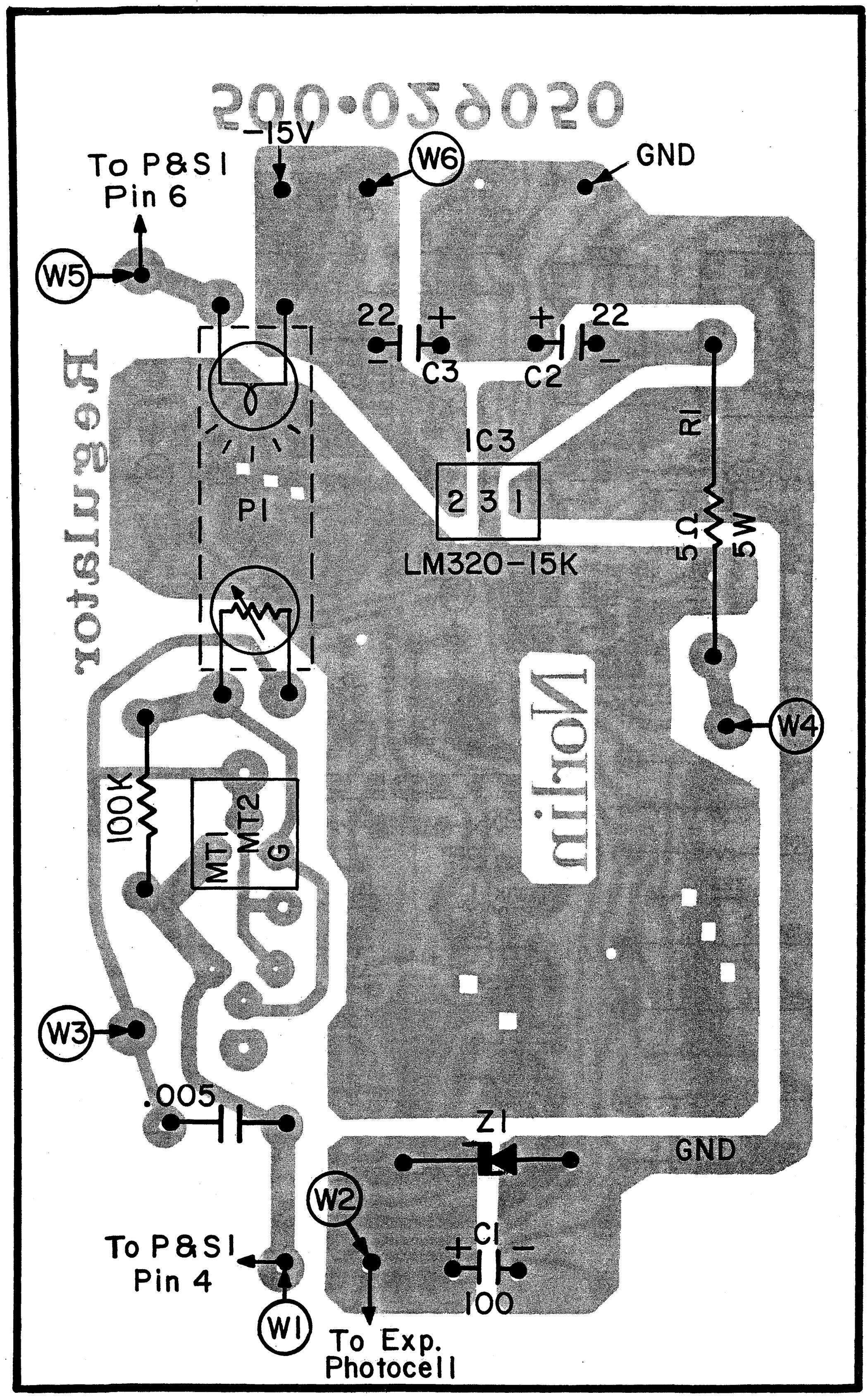

Side of organ
Remove these bolts

FIGURE 2

POWER SUPPLY CHASSIS
(Top View)


Minor Footswitch
BASS
Q6
Q5
IC1
IC2
Glide/Sustain Footswitch
Expression Pedal Photocell
T2
Q5
MAIN
Q6
Q6
CHORUS 3
Q5
Crossover Board
T1
Q6
CHORUS 2
Q5
Q5
LESLIE
Q6
P&S 2
P&S 1
P&S 3
To Bass Speakers
To Chorus 2 Speaker
To Leslie Speaker
To Main Speaker
To Chorus 3 Speaker

BOARD "W" REGULATOR


-15V
To P&S I
Pin 6
W6
GND
W5
22
+
C3
+
22
C2
IC3
2 3 1
LM320-15K
R1
5Ω
5W
P1
W4
100K
MT1
MT2
G
W3
.005
Z1
GND
W2
+
C1
-
100
To P&S I
Pin 4
W1
To Exp.
Photocell

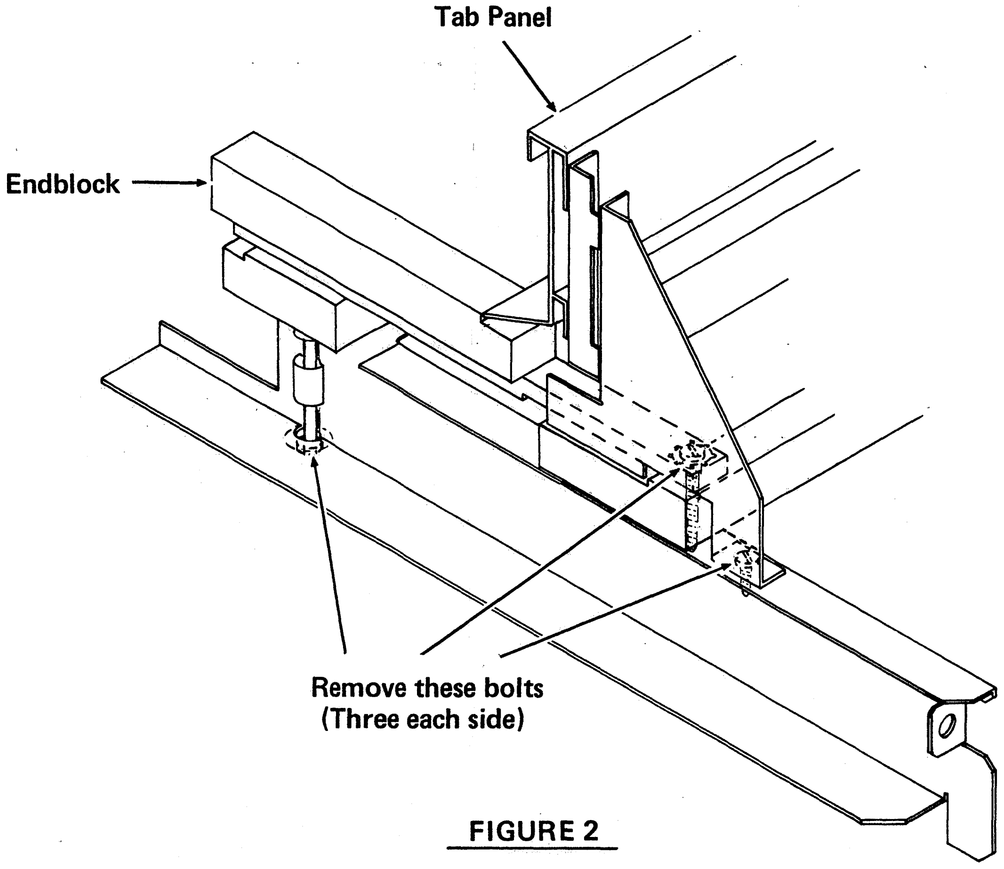

Tab Panel
Endblock
Remove these bolts
(Three each side)

FIGURE 2

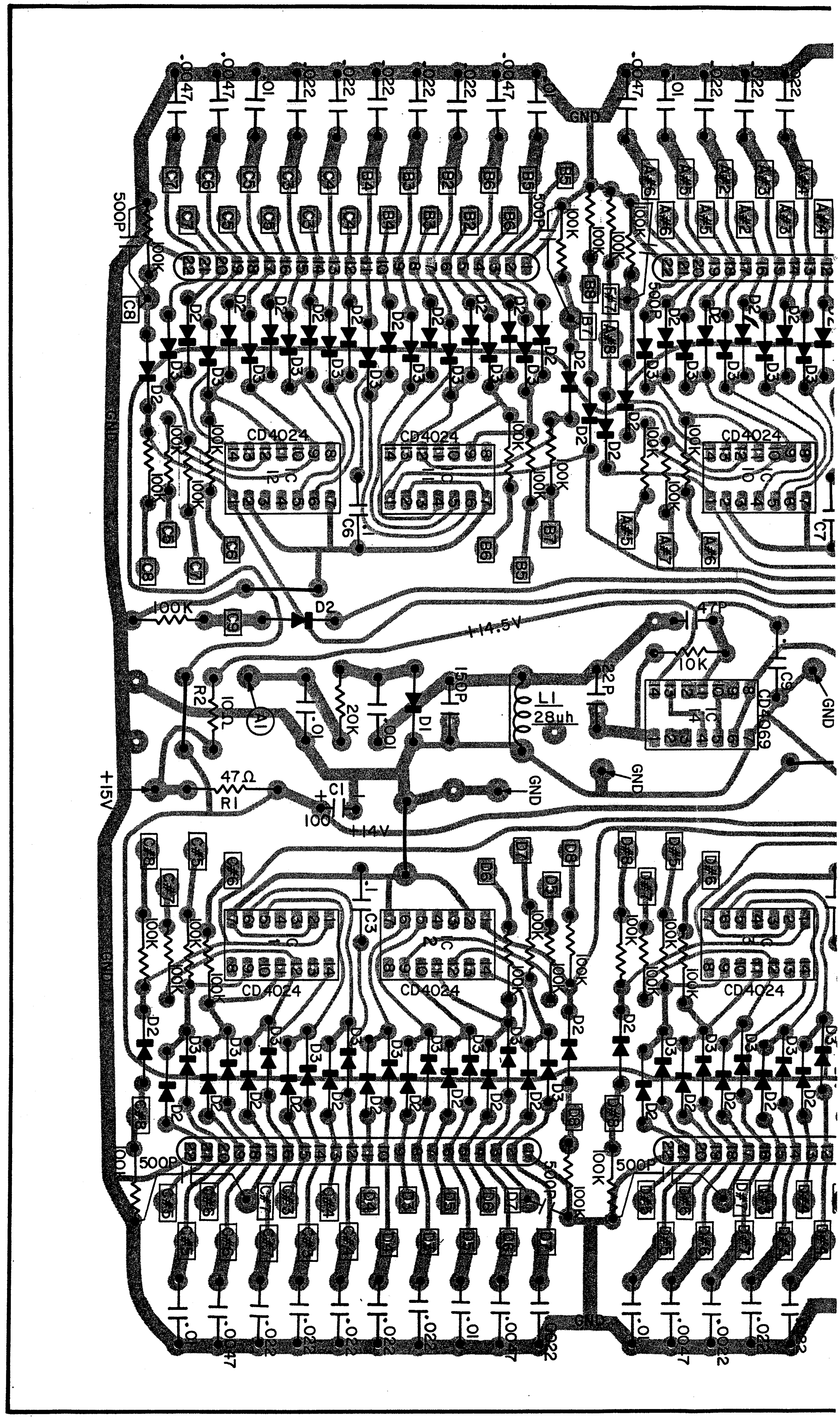
ACCESS TO LOWER KEYSWITCH CONTACTS

1) Lower circuit board tray assembly
2) Remove three bolts from the left and right tab rail brackets (see Figure 2)
3) Slide upper keyboard toward rear of organ

TAB REPLACEMENT

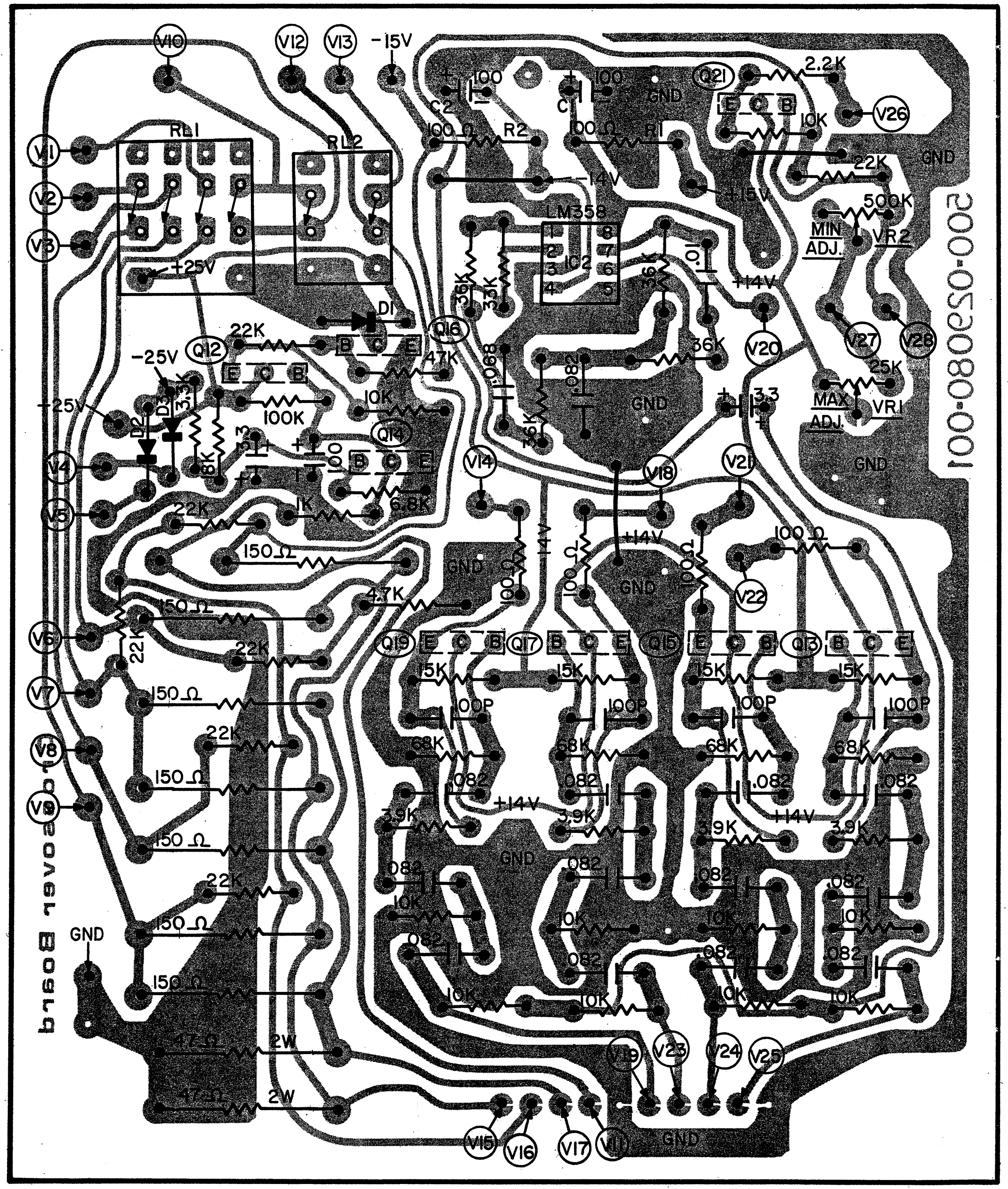
1) Slide tray assembly out of cabinet
2) Grasp tab and apply steady upward pressure to release tab from pivot rod
3) Loosen tabswitch assembly
4) Remove and replace tab
5) Apply steady downward pressure until tab snaps onto pivot rod
6) Check tab for proper operation
7) Tighten tabswitch assembly

BOARD "A"

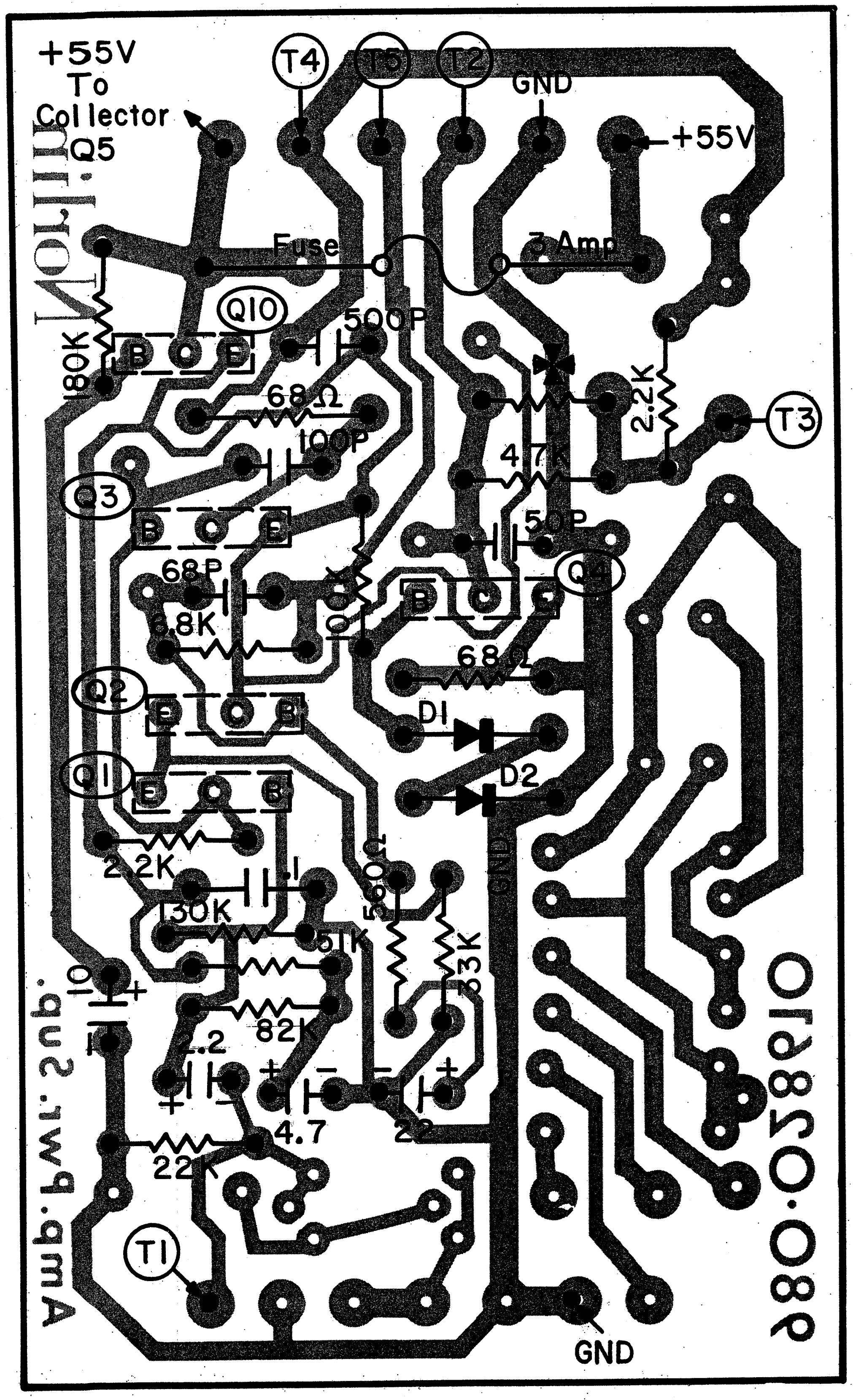

CD4024
CD4069
L1
28uh
+14.5V
+14V
+15V
GND
500P
100K
10K
47Ω
R1
R2
C1
100
D1
D2
D3
IC1
IC2
IC3

BOARD "V" CROSSOVER

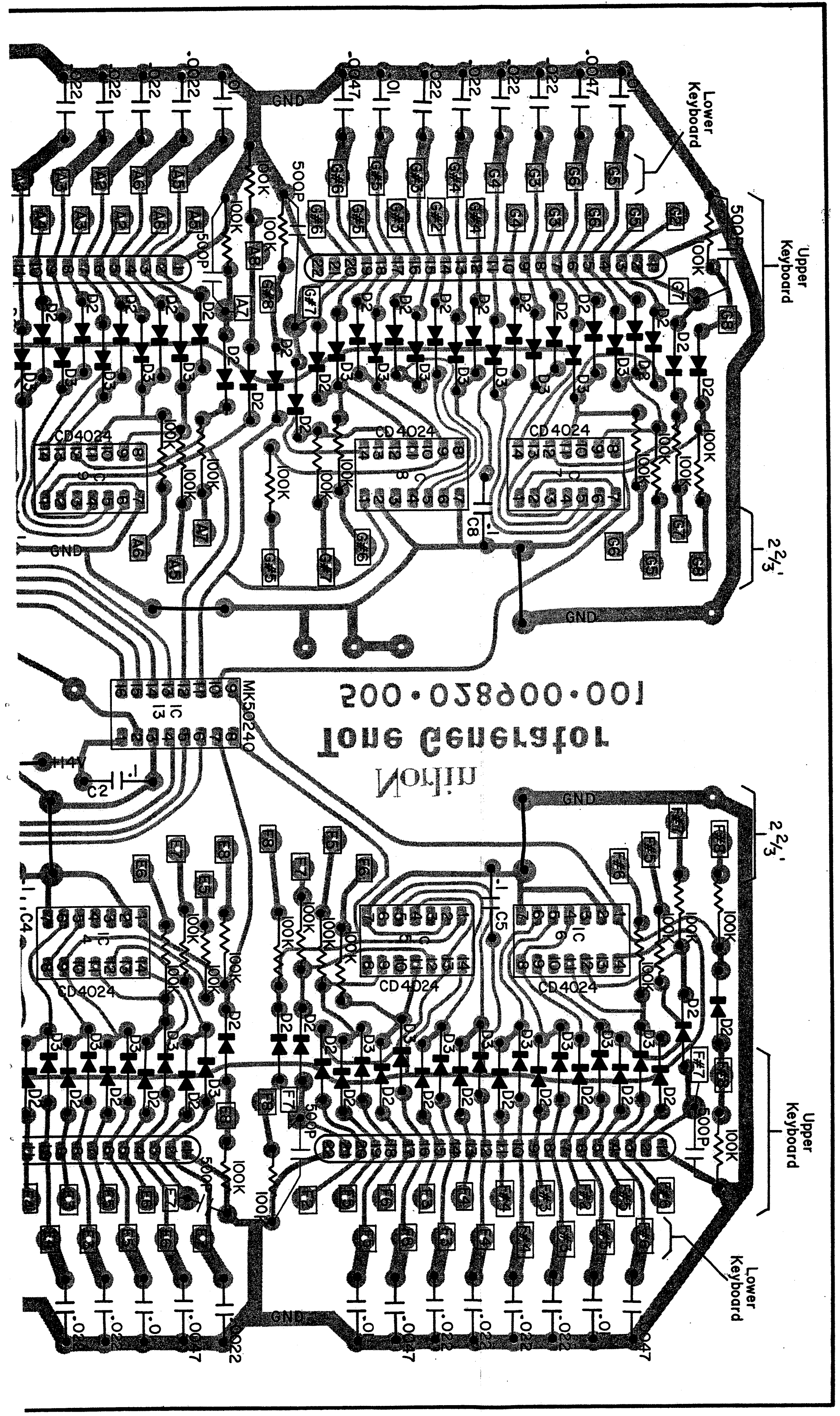
TOP


V10
V12
V13
-15V
V1
V2
V3
V4
V5
V6
V7
V8
V9
RL1
RL2
+25V
-25V
D1
Q12
Q14
Q16
Q21
LM358
IC2
+14V
-14V
+15V
V14
V18
V20
V21
V22
V26
V27
V28
MIN.
ADJ.
VR2
MAX
ADJ.
VR1
500K
25K
2.2K
22K
GND
Q19
Q17
Q15
Q13
15K
100P
68K
.082
3.9K
10K
150 Ω
47 Ω
2W
V15
V16
V17
V11
V19
V23
V24
V25
500-02080-001
Crossover Board

BOARD "T" AMPLIFIER

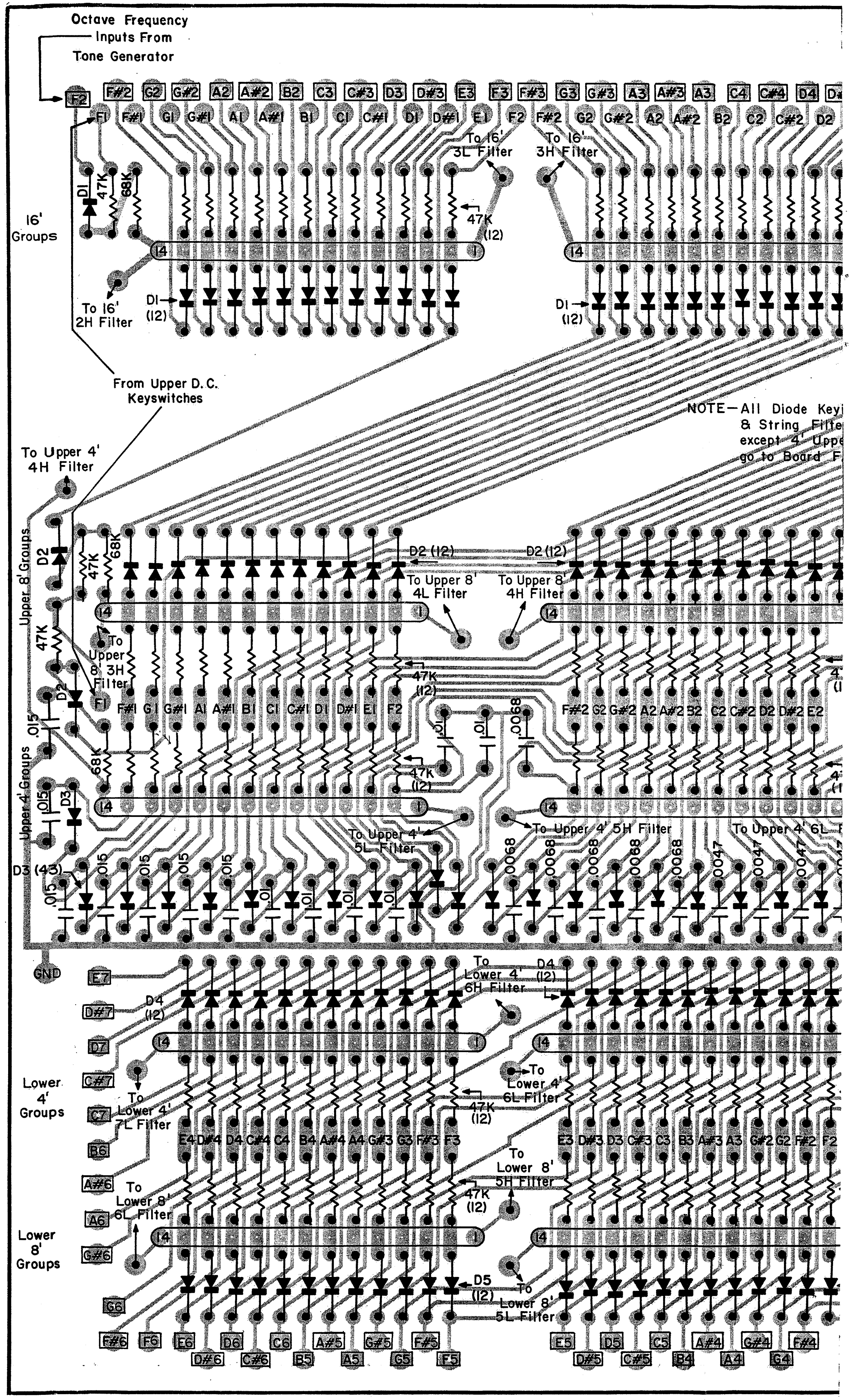

+55V
To
Collector
Q5
T4
T5
T2
GND
+55V
Fuse
3 Amp
Q10
500P
180K
68Ω
100P
2.2K
T3
47
Q3
B
E
50P
Q4
68P
6.8K
68
D1
D2
Q2
Q1
2.2K
30K
51K
560
33K
10
2.2
82K
4.7
22
22K
T1
GND
Amp. Pwr. Sup.

TONE GENERATOR

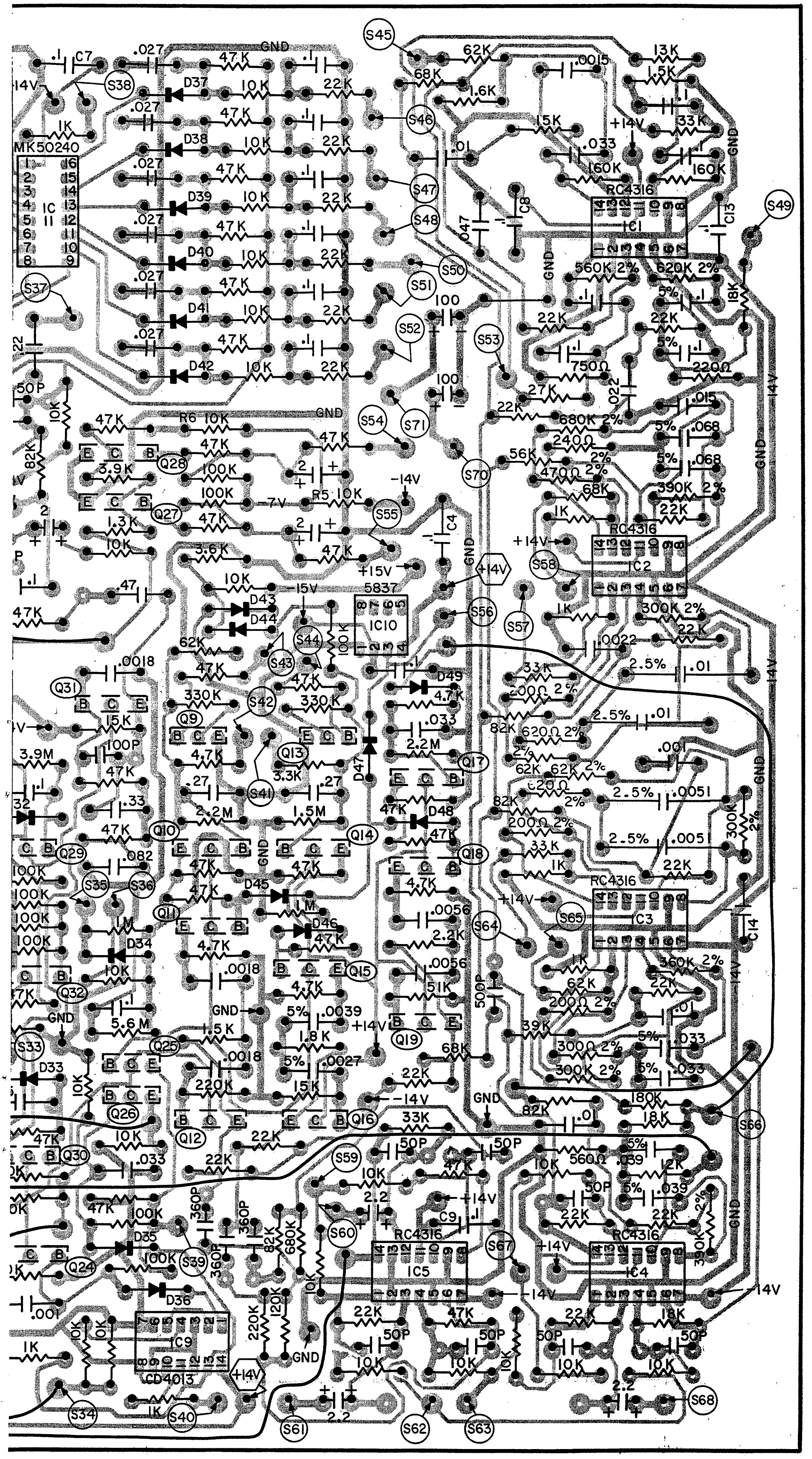

Lower Keyboard
Upper Keyboard
2 2/3'
CD4024
MK50240
IC 13
C2
C4
C5
C8
GND
500P
100K
500·028600·001
Tone Generator
Norlin
2 2/3'
Upper Keyboard
Lower Keyboard

TOP

TOP BOARD "B" UPPER/INSTRUMENTATION TOP



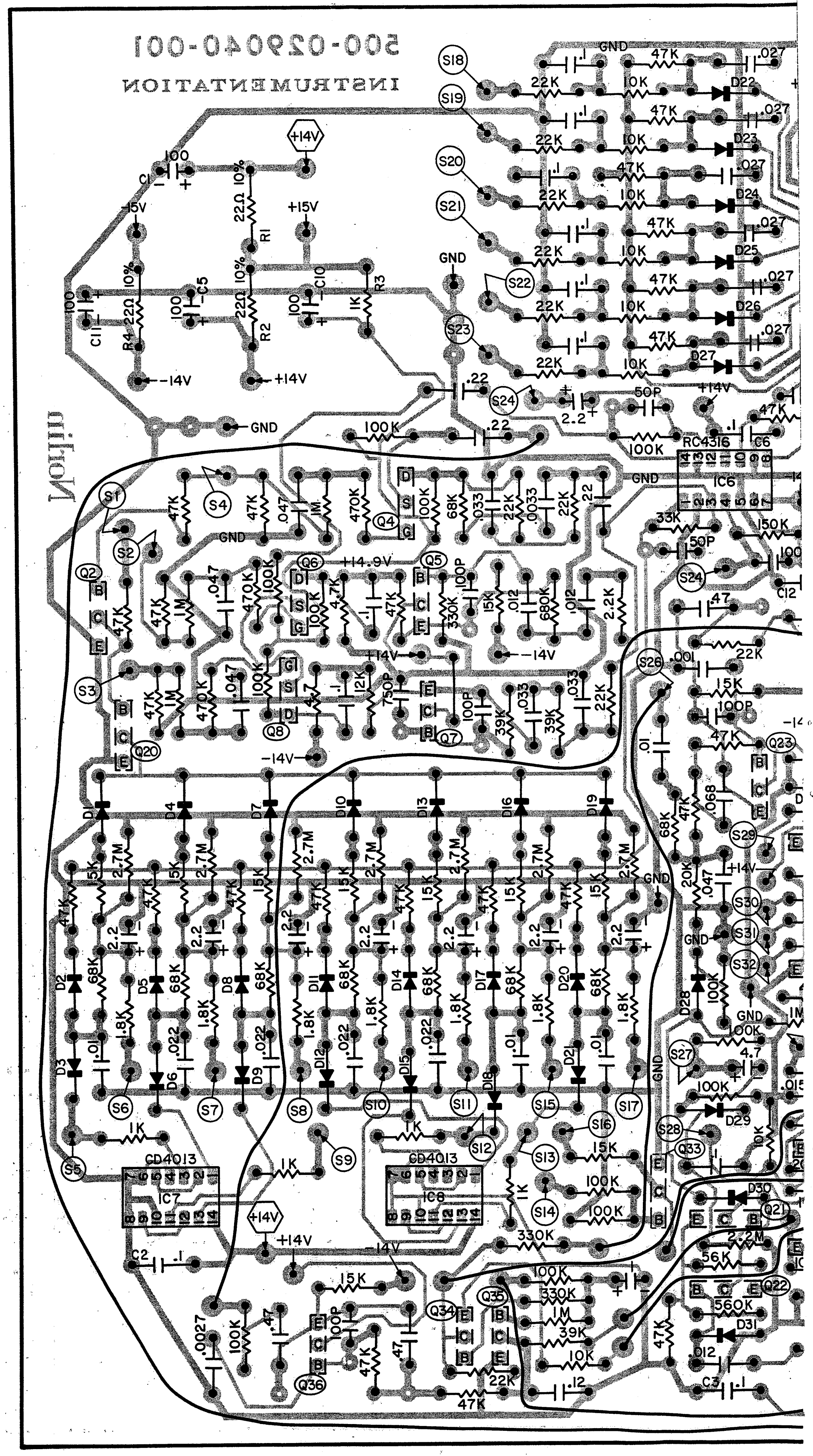
Octave Frequency Inputs From Tone Generator
F2 F#2 G2 G#2 A2 A#2 B2 C3 C#3 D3 D#3 E3 F3 F#3 G3 G#3 A3 A#3 A3 C4 C#4 D4
F1 F#1 G1 G#1 A1 A#1 B1 C1 C#1 D1 D#1 E1 F2 F#2 G2 G#2 A2 A#2 B2 C2 C#2 D2
To 16' 3L Filter
To 16' 3H Filter
16' Groups
D1
47K
68K
47K (12)
To 16' 2H Filter
D1 (12)
From Upper D.C. Keyswitches
NOTE—All Diode Keyi & String Filte except 4' Uppe go to Board F
To Upper 4' 4H Filter
Upper 8' Groups
D2
D2 (12)
To Upper 8' 4L Filter
To Upper 8' 4H Filter
To Upper 8' 3H Filter
47K (12)
Upper 4' Groups
D3
D3 (43)
To Upper 4' 5L Filter
To Upper 4' 5H Filter
To Upper 4' 6L
GND
Lower 4' Groups
E7 D#7 D7 C#7 C7 B6 A#6 A6 G#6 G6 F#6 F6
D4 (12)
To Lower 4' 6H Filter
To Lower 4' 7L Filter
To Lower 4' 6L Filter
E4 D#4 D4 C#4 C4 B4 A#4 A4 G#3 G3 F#3 F3
E3 D#3 D3 C#3 C3 B3 A#3 A3 G#2 G2 F#2 F2
To Lower 8' 5H Filter
To Lower 8' 6L Filter
Lower 8' Groups
D5 (12)
To Lower 8' 5L Filter
E6 D#6 D6 C#6 C6 B5 A#5 A5 G#5 G5 F#5 F5
E5 D#5 D5 C#5 C5 B4 A#4 A4 G#4 G4 F#4



S45 S38 S46 S47 S48 S49 S50 S51 S52 S53 S37 S54 S71 S70 S55 S58 S56 S57 S44 S43 S42 S41 S64 S65 S35 S36 S39 S33 S66 S59 S60 S67 S34 S40 S61 S62 S63 S68
MK50240 IC11
D37 D38 D39 D40 D41 D42 D43 D44 D45 D46 D47 D48 D49 D33 D34 D35 D36
RC4316 IC1
RC4316 IC2
RC4316 IC3
RC4316 IC4
RC4316 IC5
5837 IC10
CD4013 IC9
Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32
C4 C7 C8 C9 C13 C14
GND +14V -14V +15V -15V -7V

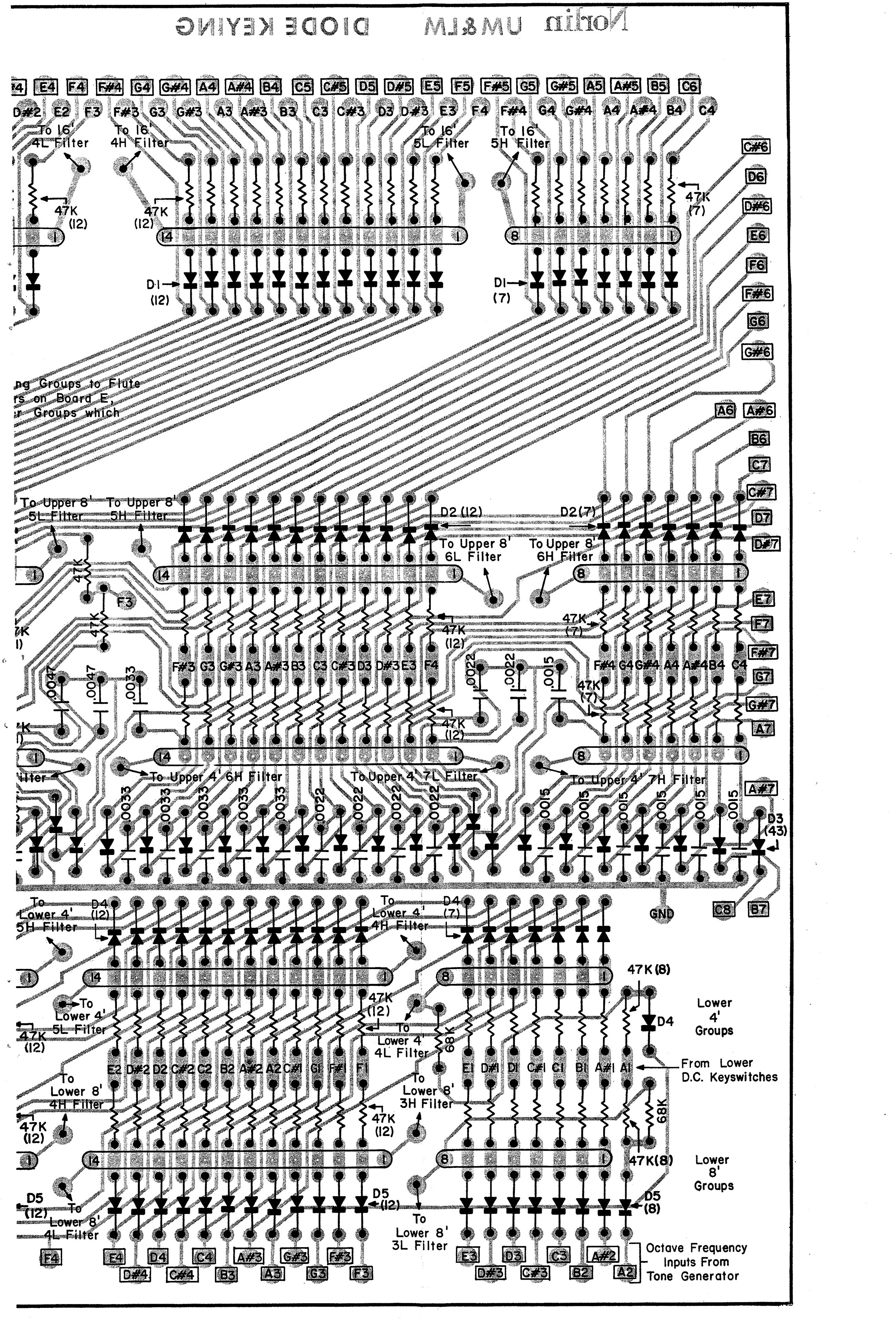
TOP

BOARD "S"

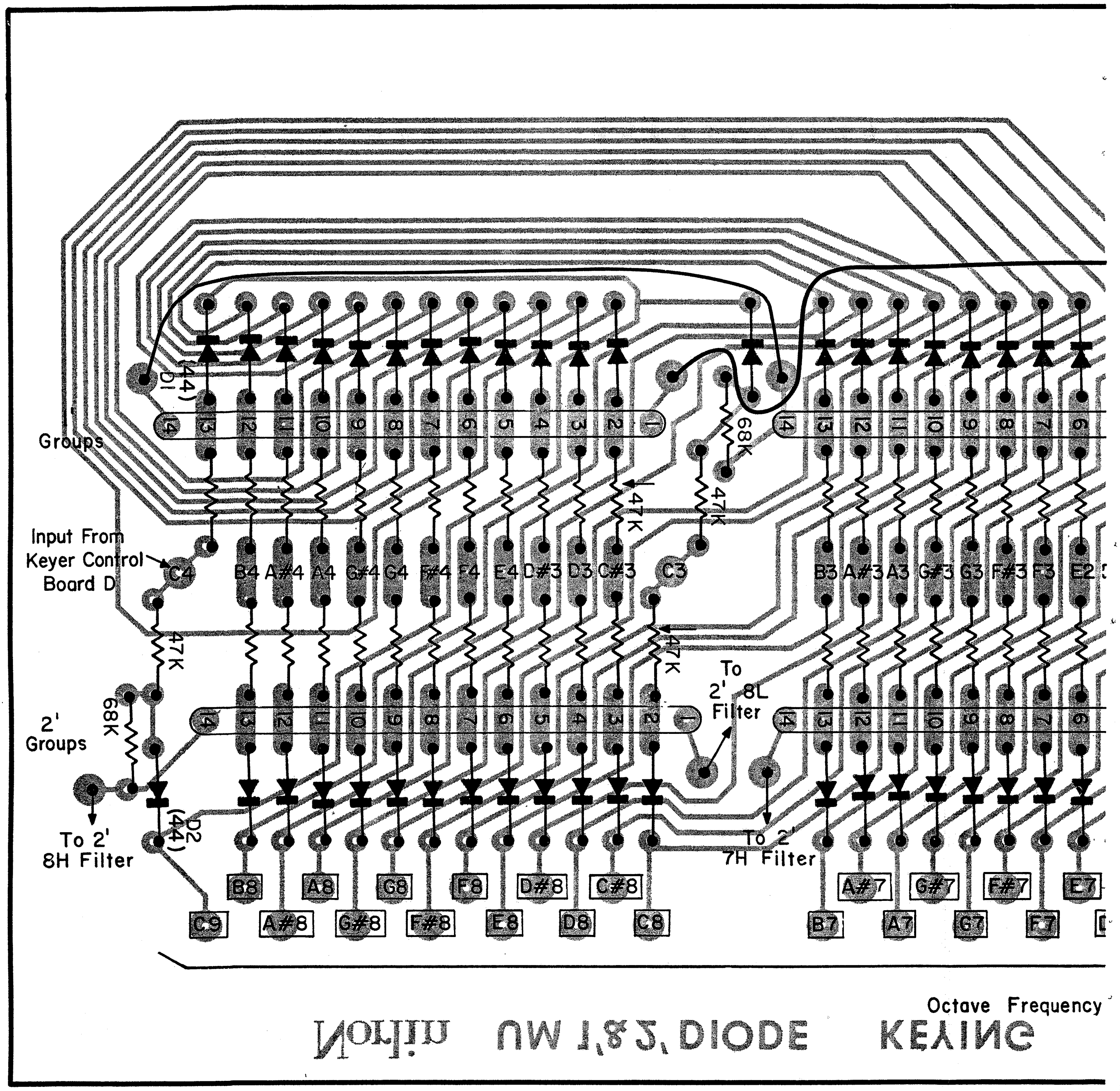

500-029040-001
INSTRUMENTATION
Nordin
+14V
+15V
-14V
GND
+14.9V
RC4316
IC6
CD4013
IC7
IC8
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24
S26
S27
S28
S29
S30
S31
S32
Q2
Q4
Q5
Q6
Q7
Q8
Q20
Q21
Q22
Q23
Q33
Q34
Q35
Q36
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
D29
D30
D31
R1
R2
R3
R4
C1
C2
C3
C5
C6
C10
C11
C12

LOWER DIODE KEYING

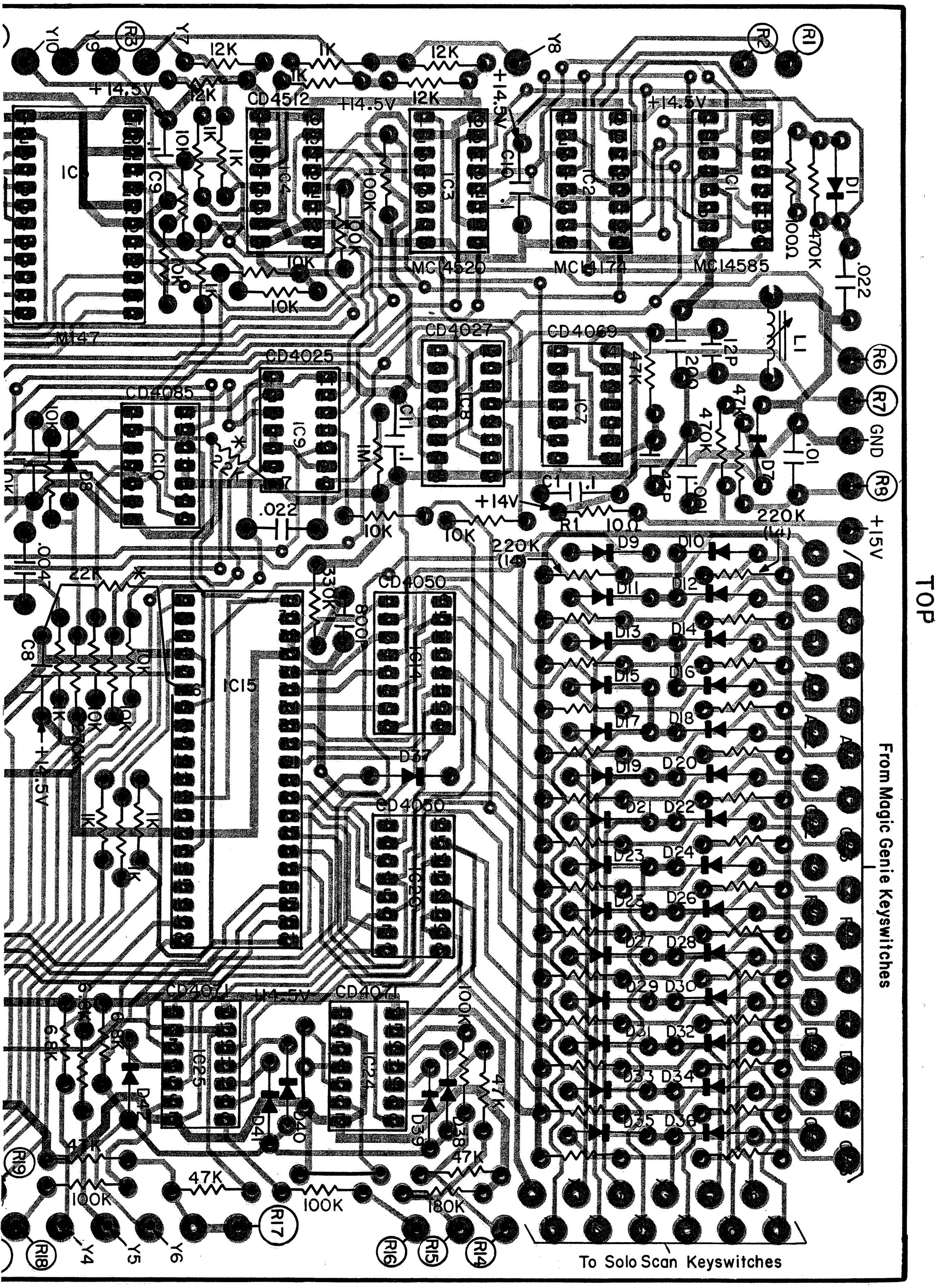
TOP


Nordin UM&LM DIODE KEYING
To 16' 4L Filter
To 16' 4H Filter
To 16' 5L Filter
To 16' 5H Filter
47K (12)
47K (7)
D1 (12)
D1 (7)
To Upper 8' 5L Filter
To Upper 8' 5H Filter
To Upper 8' 6L Filter
To Upper 8' 6H Filter
D2 (12)
D2 (7)
47K (12)
47K (7)
To Upper 4' 6H Filter
To Upper 4' 7L Filter
To Upper 4' 7H Filter
D3 (43)
To Lower 4' 5H Filter
To Lower 4' 4H Filter
D4 (12)
D4 (7)
To Lower 4' 5L Filter
To Lower 4' 4L Filter
47K (8)
D4
Lower 4' Groups
From Lower D.C. Keyswitches
To Lower 8' 4H Filter
To Lower 8' 3H Filter
To Lower 8' 4L Filter
To Lower 8' 3L Filter
47K(8)
Lower 8' Groups
D5 (12)
D5 (8)
Octave Frequency Inputs From Tone Generator
GND

BOARD "C" UPPER

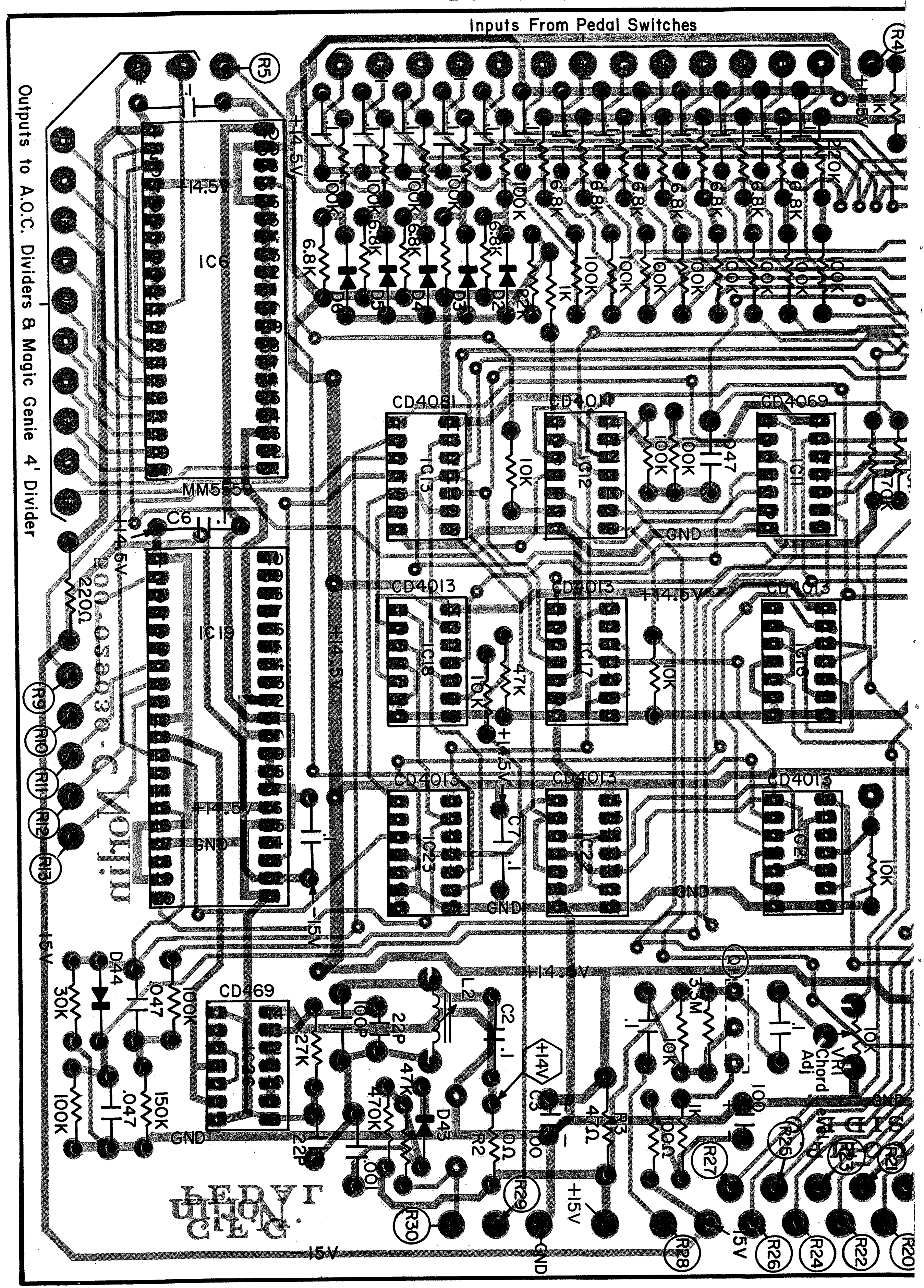

Groups
D1 (44)
68K
47K
Input From Keyer Control Board D
C4
B4 A#4 A4 G#4 G4 F#4 F4 E4 D#3 D3 C#3 C3
B3 A#3 A3 G#3 G3 F#3 F3 E2
2' Groups
To 2' 8H Filter
D2 (44)
To 2' 8L Filter
To 2' 7H Filter
B8 A8 G8 F8 D#8 C#8
C9 A#8 G#8 F#8 E8 D8 C8
A#7 G#7 F#7 E7
B7 A7 G7 F7
Octave Frequency
Norlin UW 1'&2' DIODE KEYING

C.F.G. PEDAL


Y10
Y9
R3
Y7
Y8
R2
R1
+14.5V
CD4512
MC14520
MC14174
MC14585
CD4027
CD4069
CD4025
CD4085
CD4050
CD4071
M147
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC14
IC15
IC20
IC24
IC25
L1
+14V
R6
R7
GND
R9
+15V
TOP
From Magic Genie Keyswitches
To Solo Scan Keyswitches
R19
R18
Y4
Y5
Y6
R17
R16
R15
R14

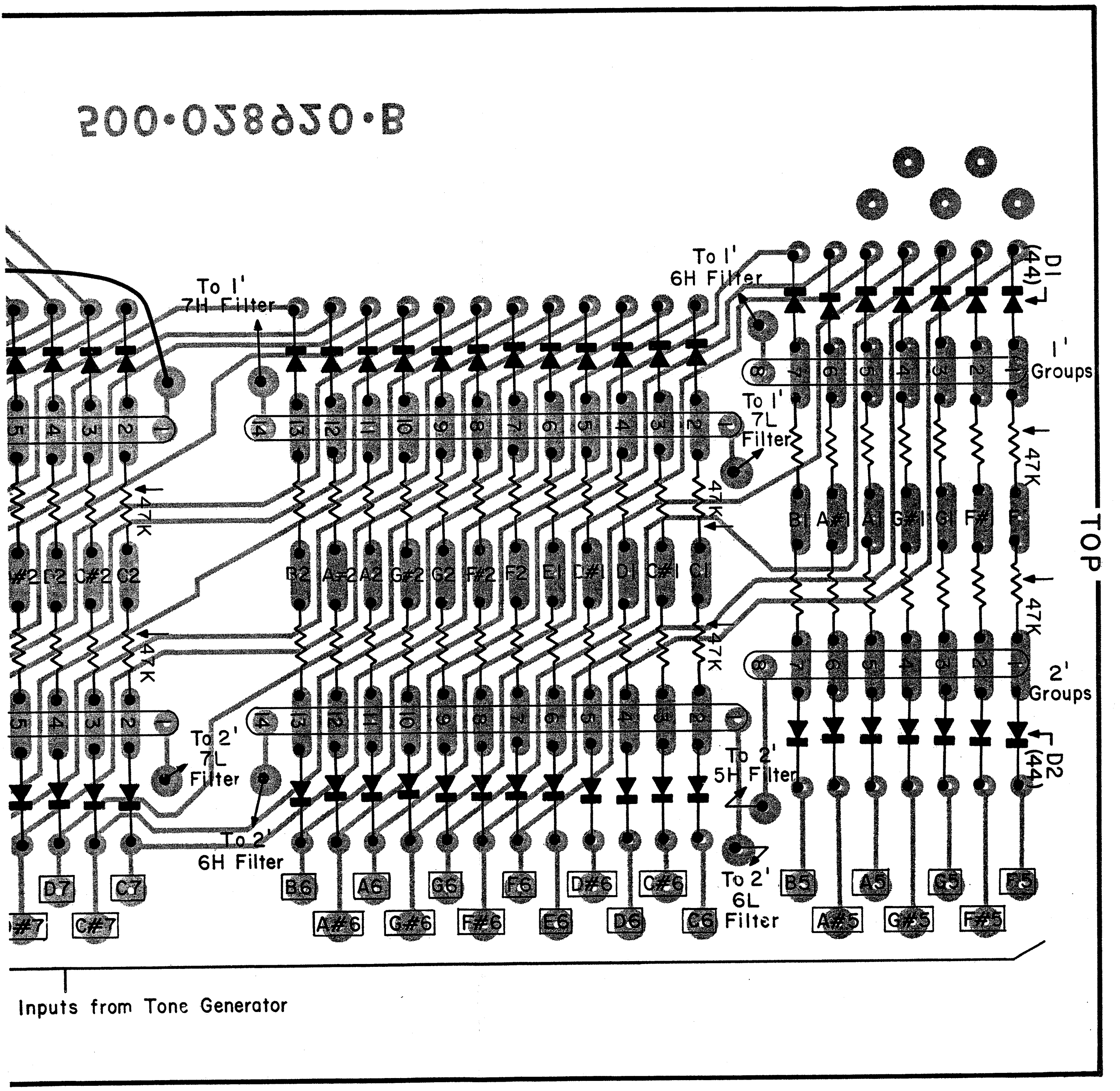
*Mounted to back of board.

BOARD "R"



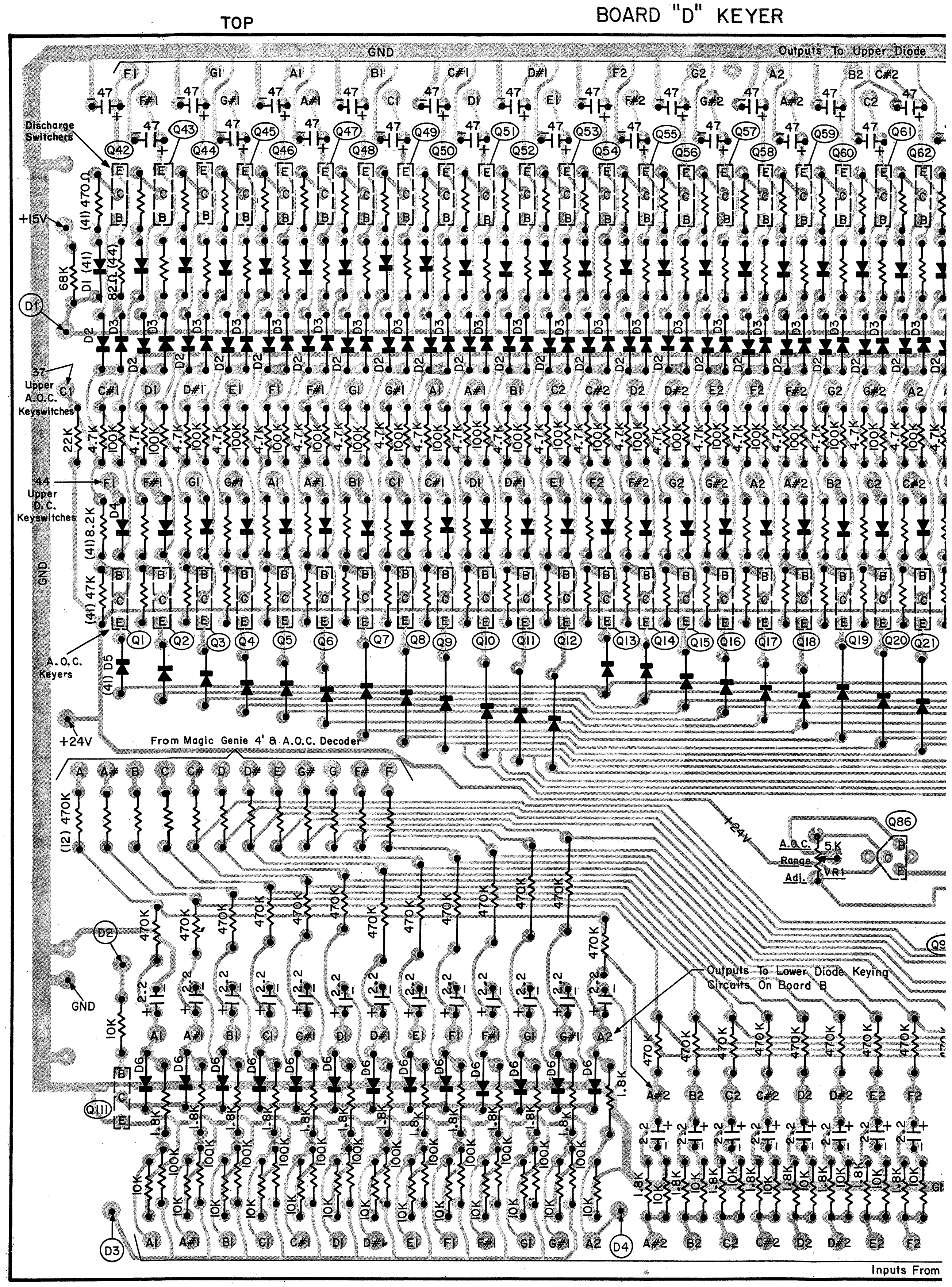
Inputs From Pedal Switches
Outputs to A.O.C. Dividers & Magic Genie 4' Divider
IC6
MM5555
IC19
C6
+14.5V
220Ω
CD4081
IC13
CD4011
IC12
CD4069
IC11
CD4013
IC18
IC17
IC16
IC23
IC22
IC21
CD469
IC26
GND
-15V
+15V
+14V
6.8K
100K
10K
47K
1K
D47
C7
C2
C3
L2
D43
D44
.047
30K
150K
27K
22P
100P
470K
4.7K
.001
R2
R3
3.3M
VR1 Chord Adj
R5
R9
R10
R11
R12
R13
R20
R22
R24
R26
R27
R28
R29
R30

KEYBOARD 1' & 2' DIODE KEYING

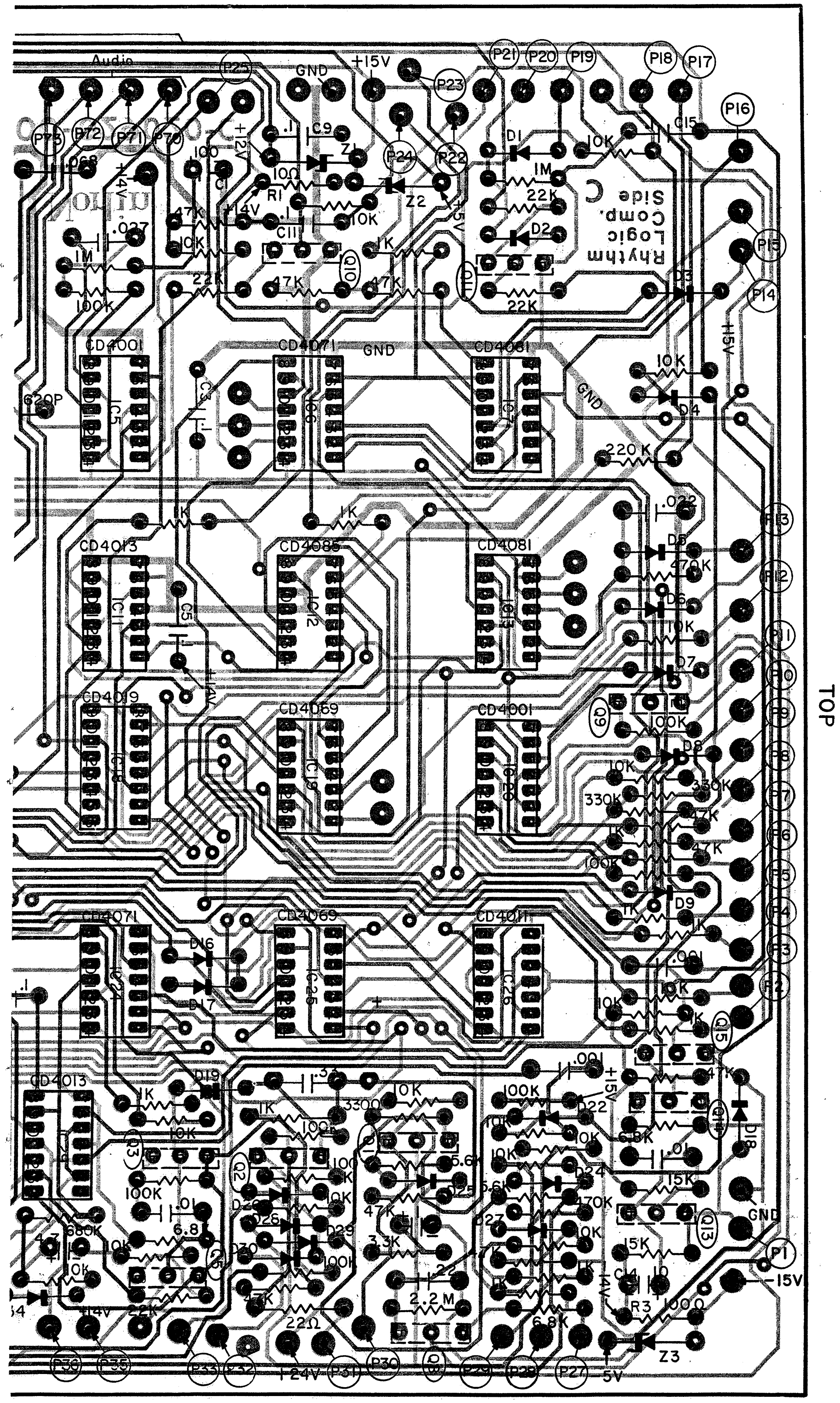


TOP
To 1' 7H Filter
To 1' 6H Filter
To 1' 7L Filter
1' Groups
2' Groups
D1 (44)
D2 (44)
47K
To 2' 7L Filter
To 2' 6H Filter
To 2' 5H Filter
To 2' 6L Filter
B1
A#1
A1
G#1
G1
F#1
F1
B2
A#2
A2
G#2
G2
F#2
F2
E1
D#1
D1
C#1
C1
D#2
D2
C#2
C2
D7
C7
B6
A6
G6
F6
D#6
C#6
D#7
C#7
A#6
G#6
F#6
E6
D6
C6
B5
A5
G5
F5
A#5
G#5
F#5
Inputs from Tone Generator

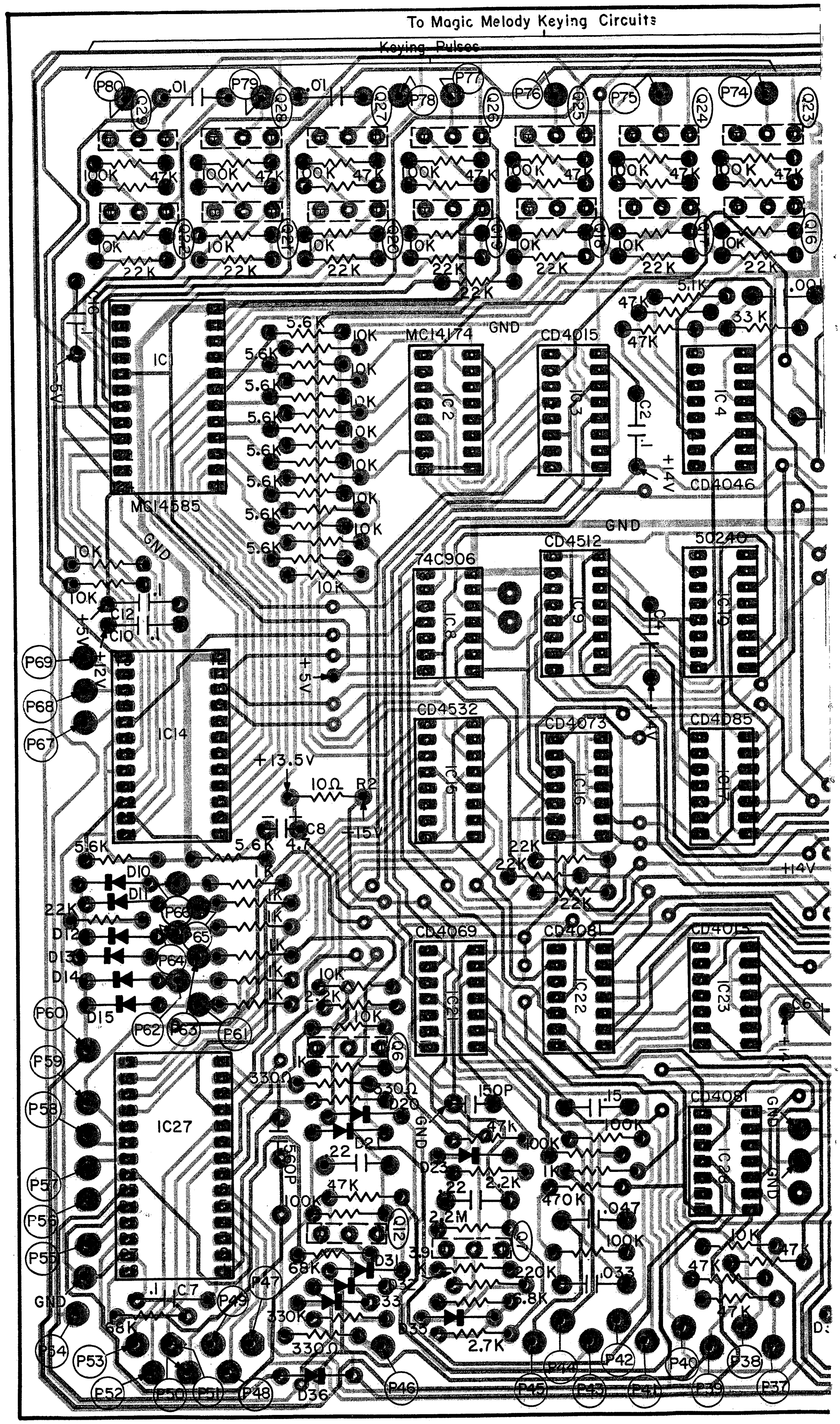
BOARD "D" KEYER


TOP
GND
Outputs To Upper Diode
Discharge Switchers
+15V
37 Upper A.O.C. Keyswitches
44 Upper D.C. Keyswitches
A.O.C. Keyers
+24V
From Magic Genie 4' & A.O.C. Decoder
A.O.C. Range Adj.
VR1
Outputs To Lower Diode Keying Circuits On Board B
Inputs From

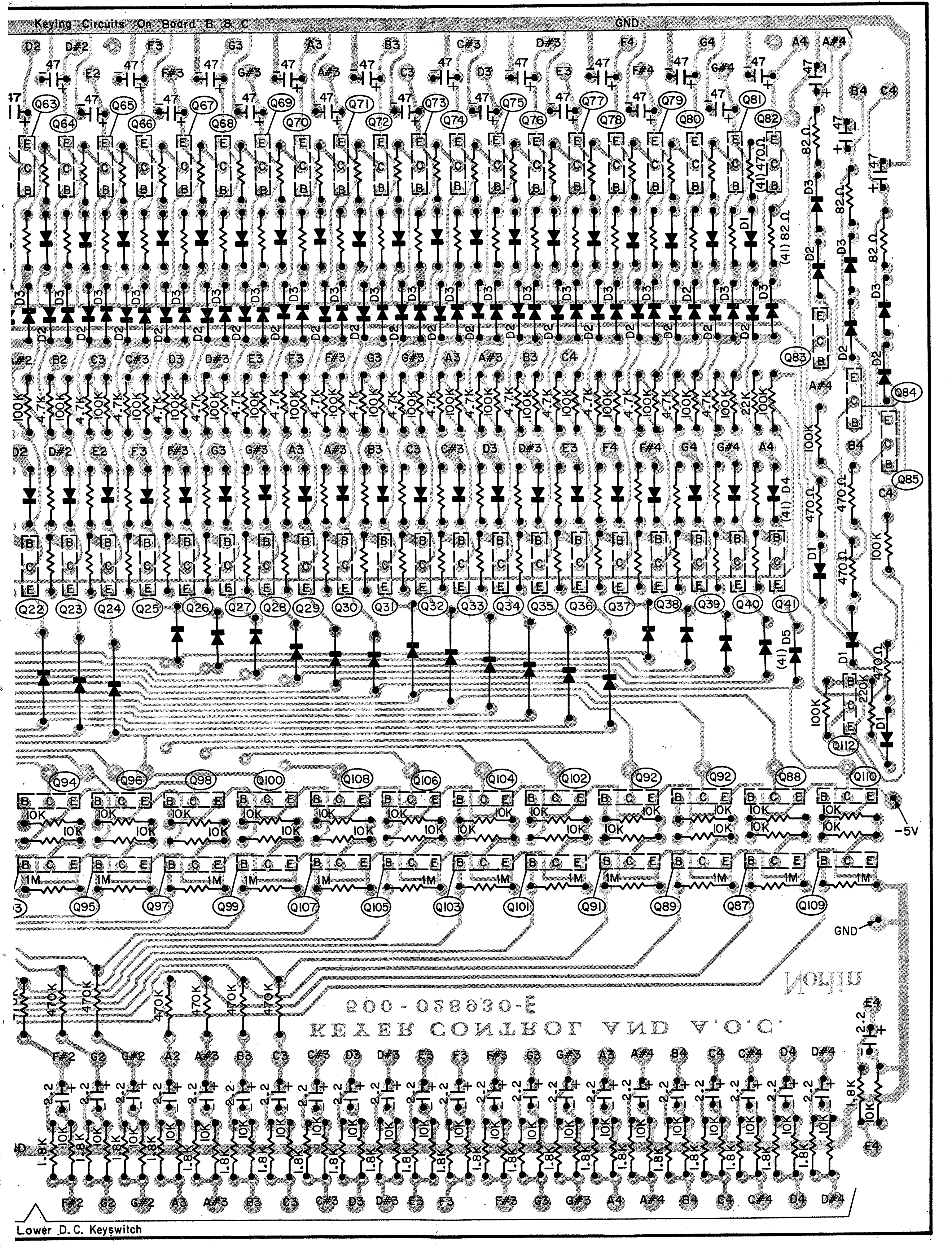
RHYTHM LOGIC


Audio
GND
+15V
Rhythm Logic Comp. Side C
CD4001
CD4071
CD4081
CD4013
CD4085
CD4019
CD4069
CD4011
-15V
+24V
5V
TOP

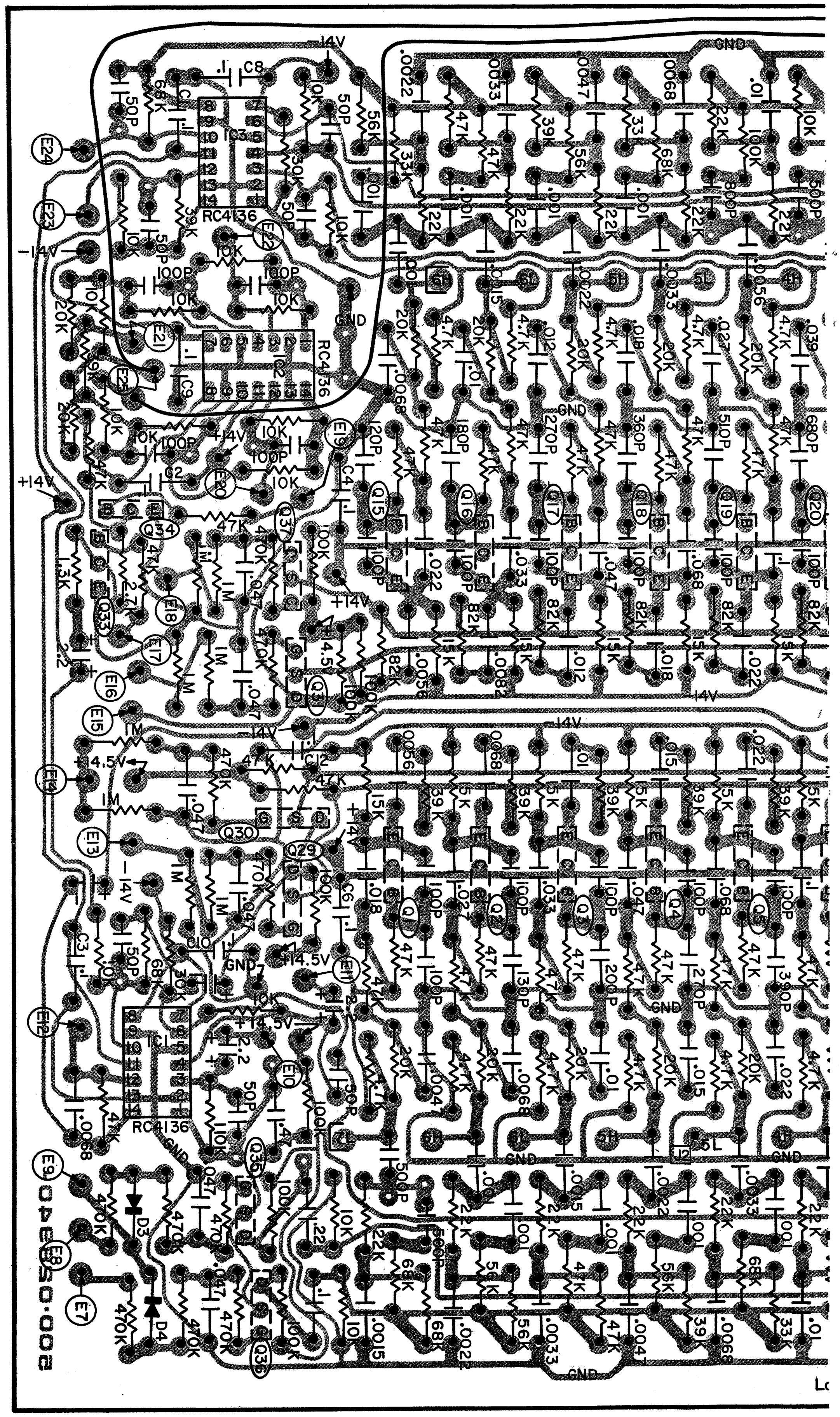
BOARD "P"


To Magic Melody Keying Circuits
Keying Pulses
MC14174
CD4015
MC14585
CD4046
74C906
CD4512
50240
CD4532
CD4073
CD4085
CD4069
CD4081
IC14
IC27
+13.5V
+5V
+12V
+14V
GND
P80
P79
P77
P76
P75
P74
P69
P68
P67
P60
P59
P58
P57
P56
P55
P54
P53
P52
P50
P51
P48
P46
P45
P43
P41
P39
P37
P42
P40
P38
D36

CONTROL & AOC


TOP
Keying Circuits On Board B & C
GND
-5V
Norlin
500-028930-E
KEYER CONTROL AND A.O.C.
Lower D.C. Keyswitch

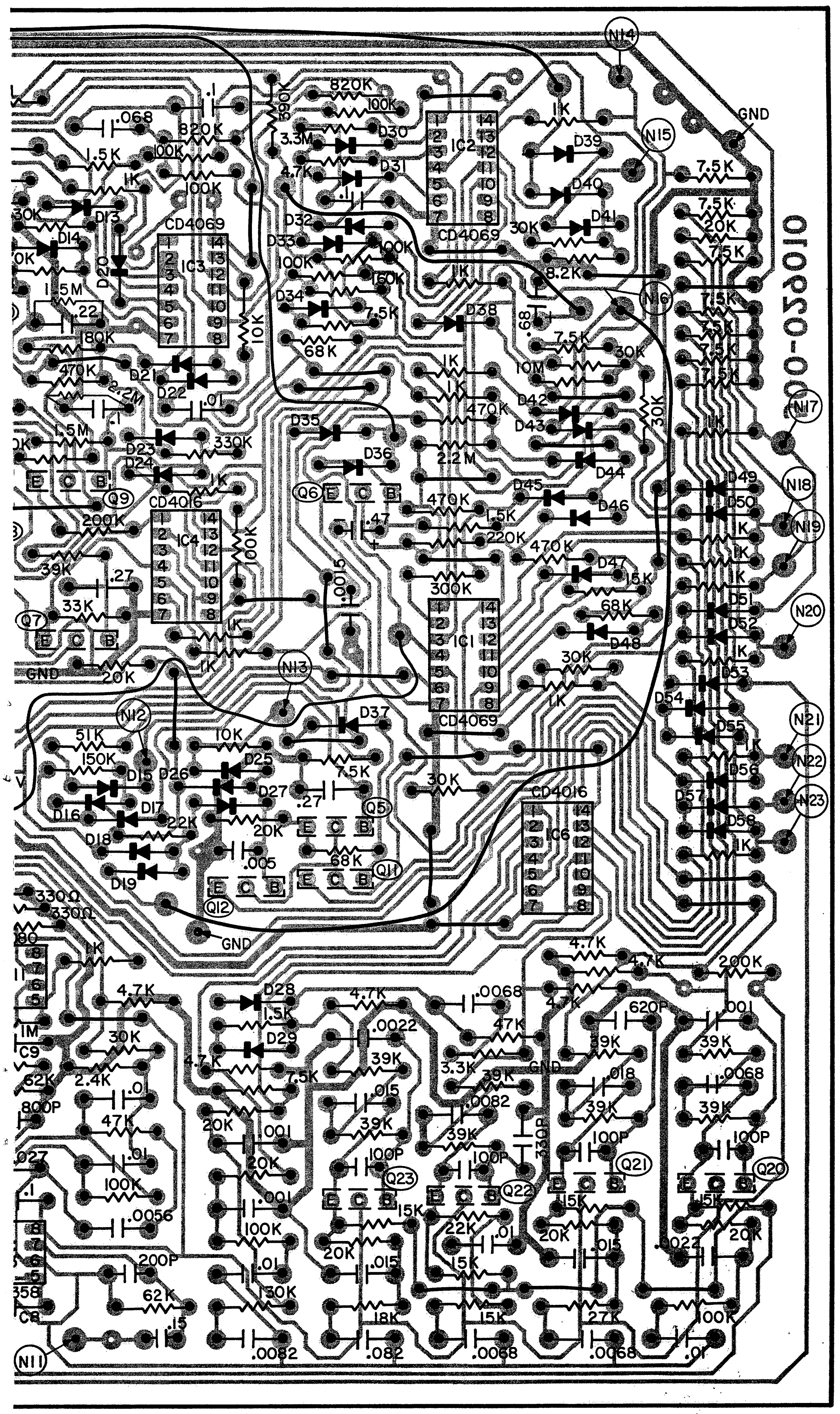
BOARD "E" UPPER/LOWER



RC4136
IC1
IC2
IC3
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
E18
E19
E20
E21
E22
E23
E24
+14V
-14V
+14.5V
GND

KEYERS & FILTERS

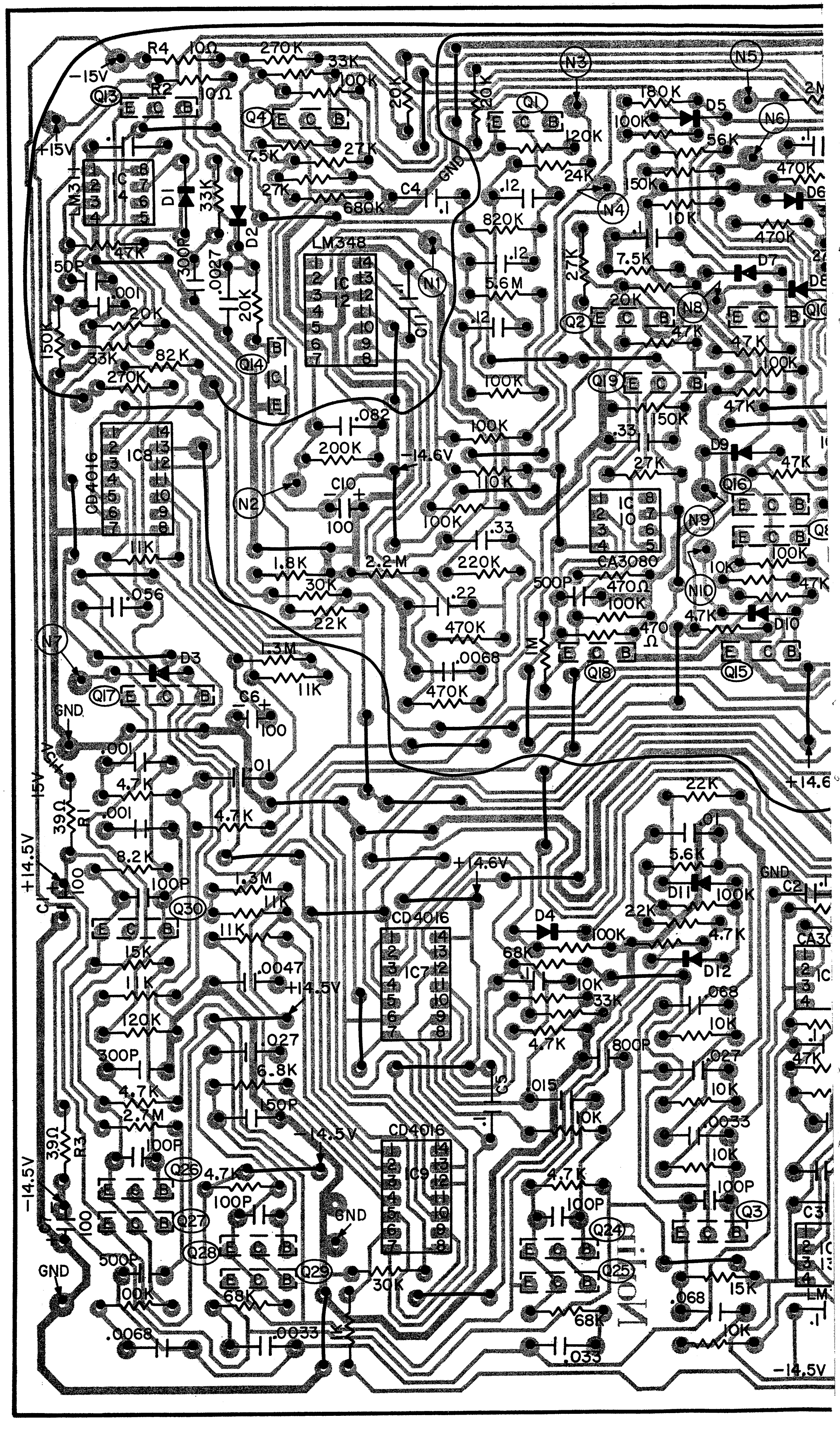
TOP



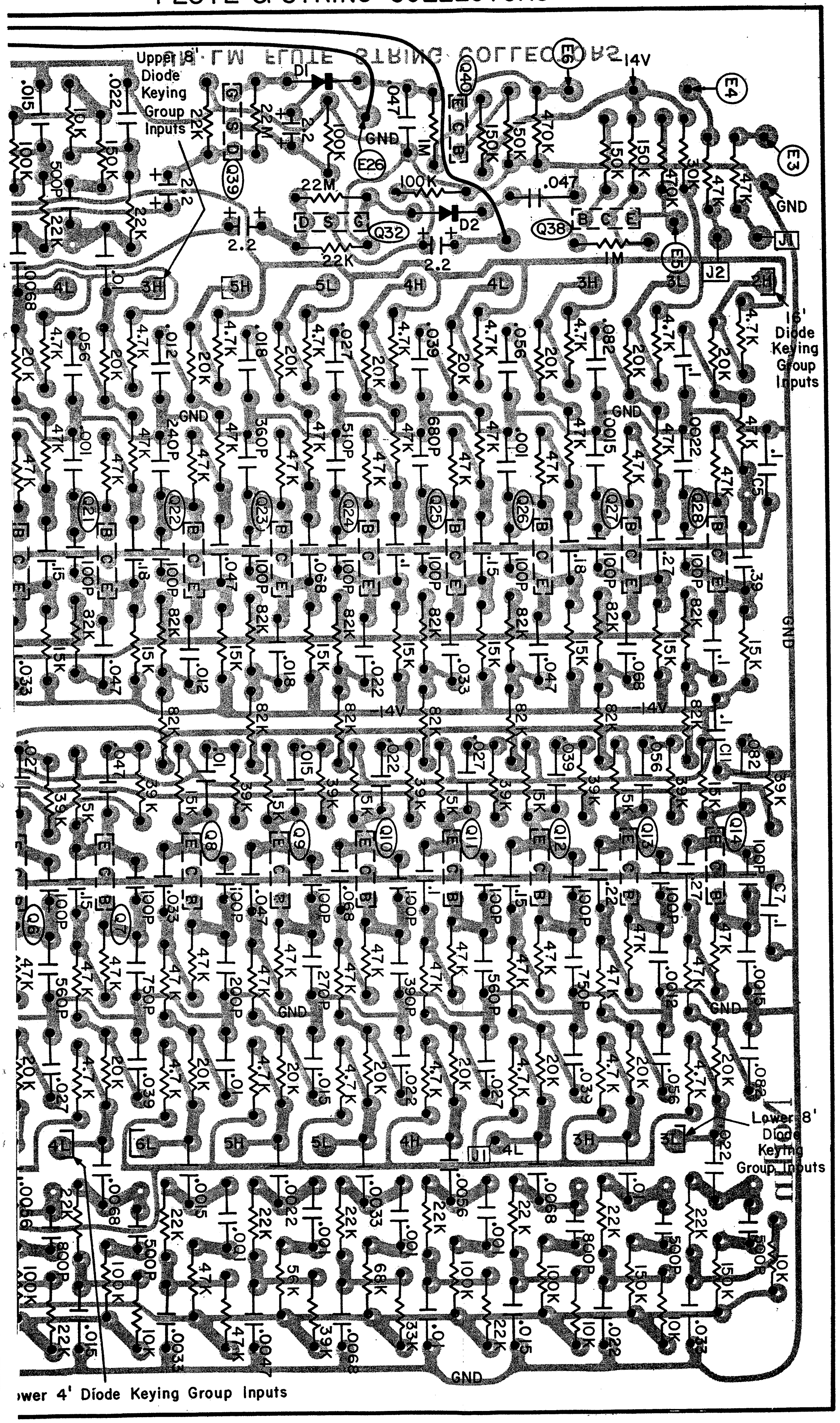
CD4069
CD4016
IC1
IC2
IC3
IC4
IC6
N11
N12
N13
N14
N15
N16
N17
N18
N19
N20
N21
N22
N23
GND

TOP

BOARD "N" SOLO


R4
10Ω
270K
33K
100K
-15V
Q13
R2
+15V
LM3
D1
D2
Q4
7.5K
27K
680K
C4
GND
LM348
IC
N1
N3
N5
N6
N4
Q1
Q2
N8
Q10
D5
D6
D7
D8
Q19
Q14
47K
50P
.001
20K
33K
82K
270K
CD4016
IC8
N2
C10
100
200K
.082
-14.6V
Q16
D9
N9
CA3080
N10
D10
Q15
Q18
470Ω
470K
500P
11K
.056
N7
D3
Q17
C6
GND
1.8K
30K
2.2M
220K
22K
.0068
3M
+14.6V
+14.5V
-14.5V
39Ω
R1
R3
.001
4.7K
8.2K
100P
Q30
15K
120K
300P
2.7M
CD4016
IC7
CD4016
IC9
D4
D11
D12
68K
C2
C3
CA3
.0047
.027
6.8K
50P
Q26
Q27
Q28
Q29
Q24
Q25
Q3
LM
GND
.0068
.0033
.015
.033
.068

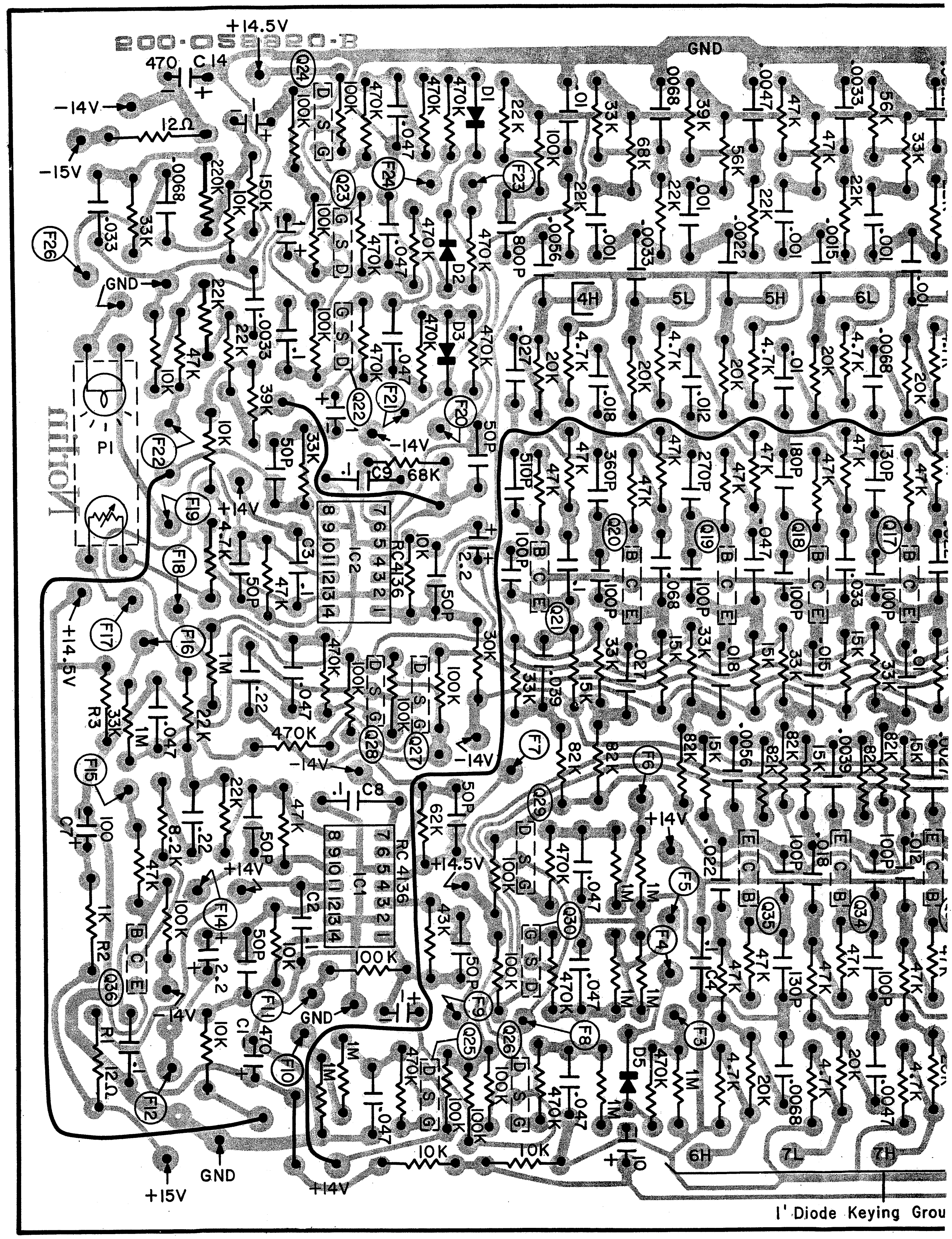
FLUTE & STRING COLLECTORS


Upper 8' Diode Keying Group Inputs
14V
E4
E3
E6
E26
E5
GND
Q40
Q39
Q32
Q38
D1
D2
22M
100K
2.2
22K
1M
.047
J1
J2
4L
3H
5H
5L
4H
16' Diode Keying Group Inputs
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
C5
GND
-14V
C1
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
C7
Lower 8' Diode Keying Group Inputs
6L
Lower 4' Diode Keying Group Inputs

TOP

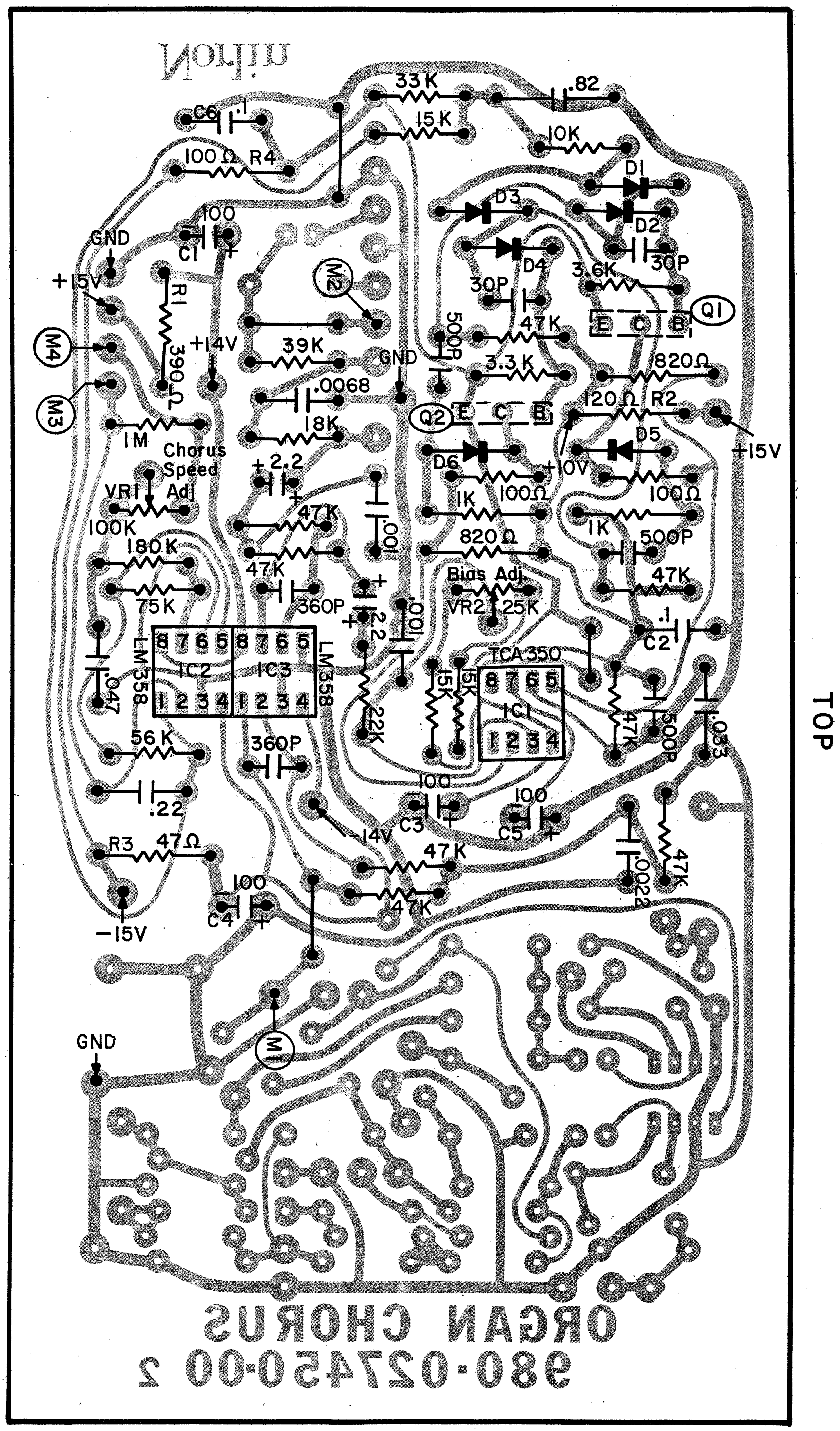
Note: ☐ Boxed J No's Indicate on board jumpers.

BOARD "F" UPPER FLUTE



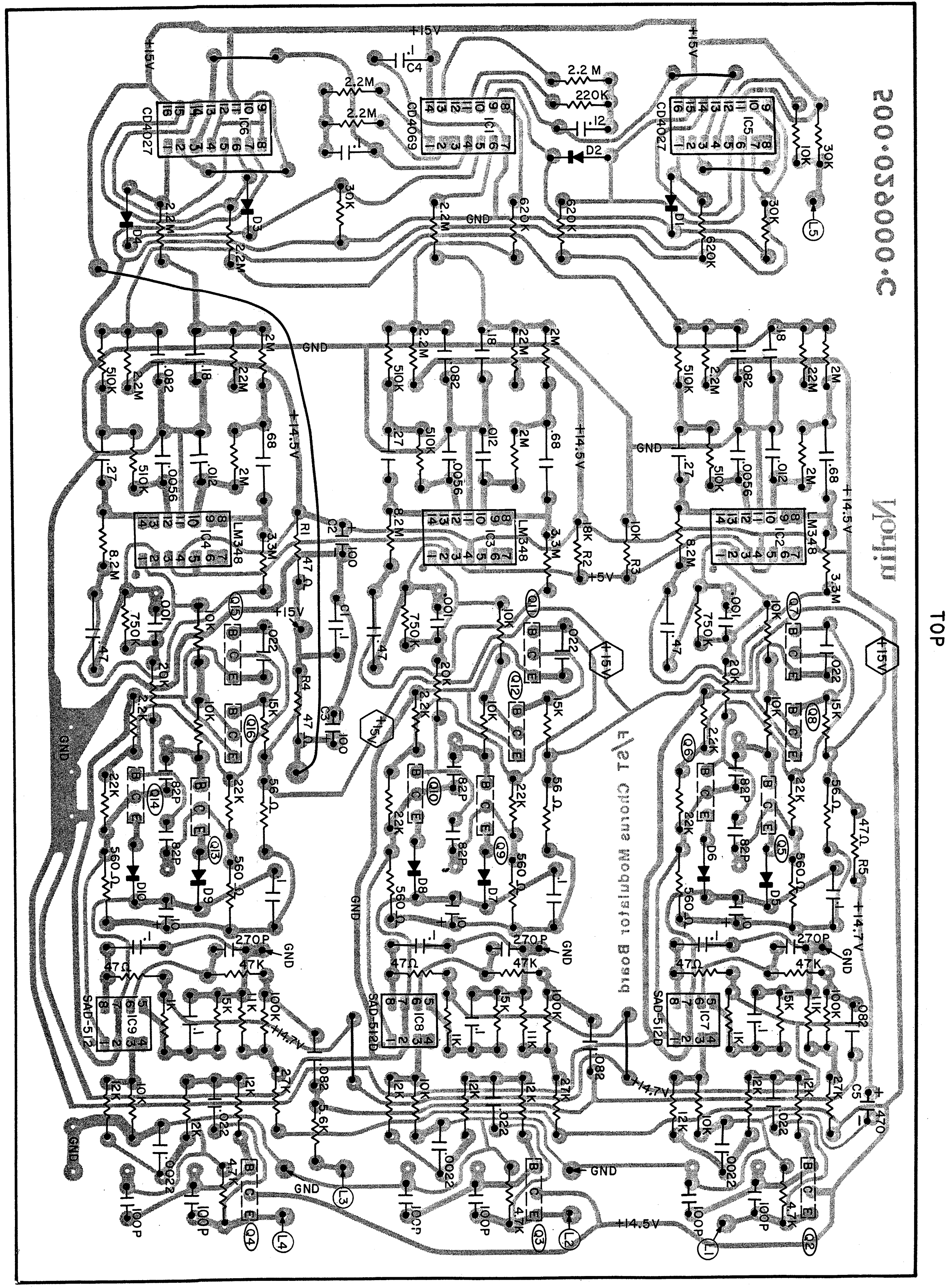
+14.5V
GND
470 C14
-14V
-15V
12Ω
F26
GND
PI
F22
F19
F18
F17
+14.5V
F16
R3
F15
C7
F14
R2
Q36
R1
F12
F11
F10
F9
GND
-14V
+14V
+15V
C1
C2
C3
C8
C9
IC1 RC4136
IC2 RC4136
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q30
Q34
Q35
F1
F2
F3
F4
F5
F6
F7
F8
F20
F21
F23
F24
D1
D2
D3
D5
4H
5L
5H
6L
6H
7L
7H
1' Diode Keying Grou

BOARD "M" REED CHORUS

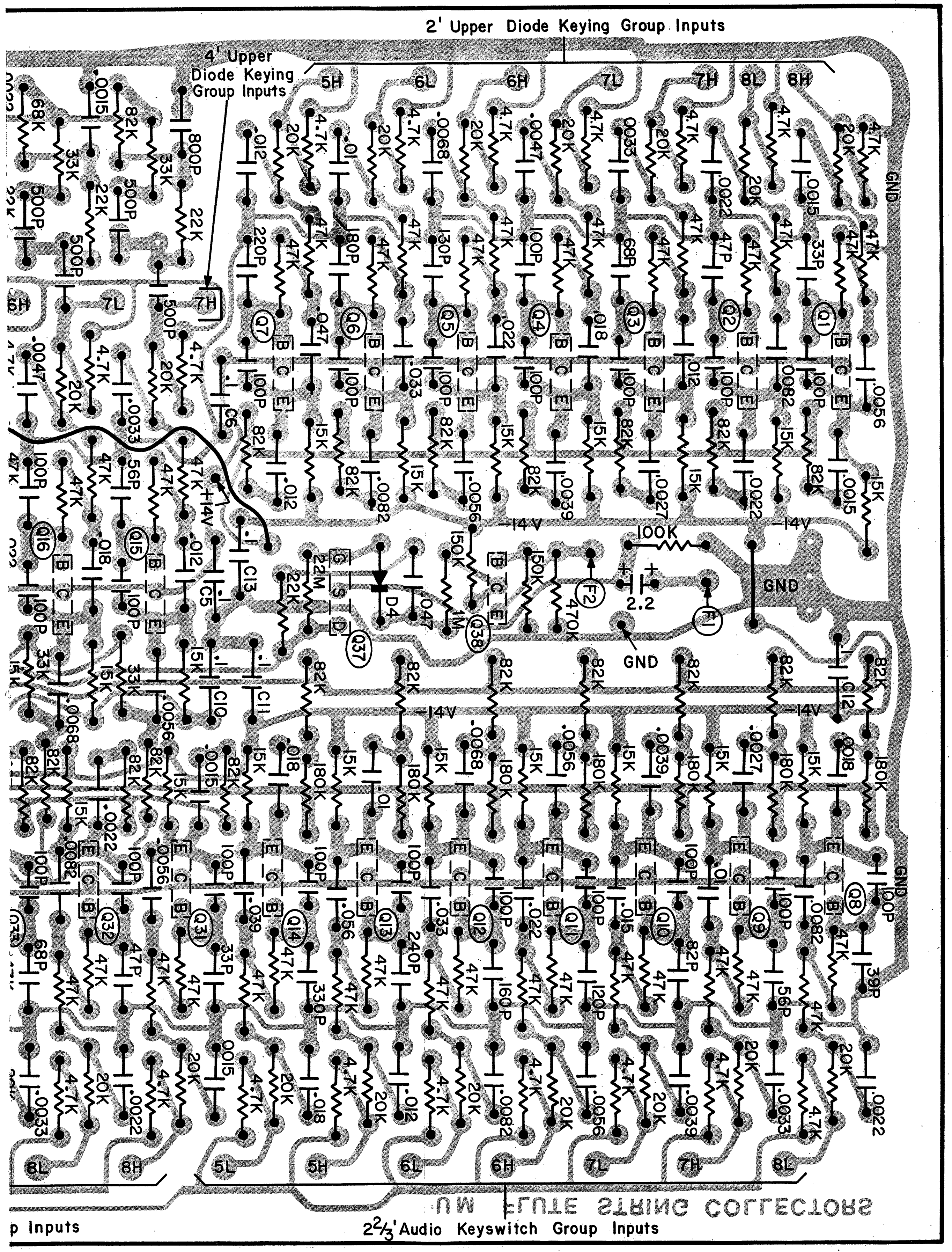


33K
.82
C6
15K
10K
100Ω R4
D1
D2
D3
D4
C1 100
GND
+15V
M2
30P
3.6K
Q1 E C B
M4
M3
R1 390Ω
+14V
39K
GND
500P
47K
3.3K
820Ω
.0068
18K
Q2 E C B
120Ω R2
1M
Chorus Speed Adj
VR1
100K
2.2
D5
D6
+10V
+15V
1K
100Ω
820Ω
180K
75K
Bias Adj
VR2 25K
TCA350
IC1
IC2 LM358
IC3 LM358
C2
56K
.22
360P
C3
C5
-14V
R3 47Ω
C4
-15V
GND
M1
ORGAN CHORUS
980-02745-00 2
TOP

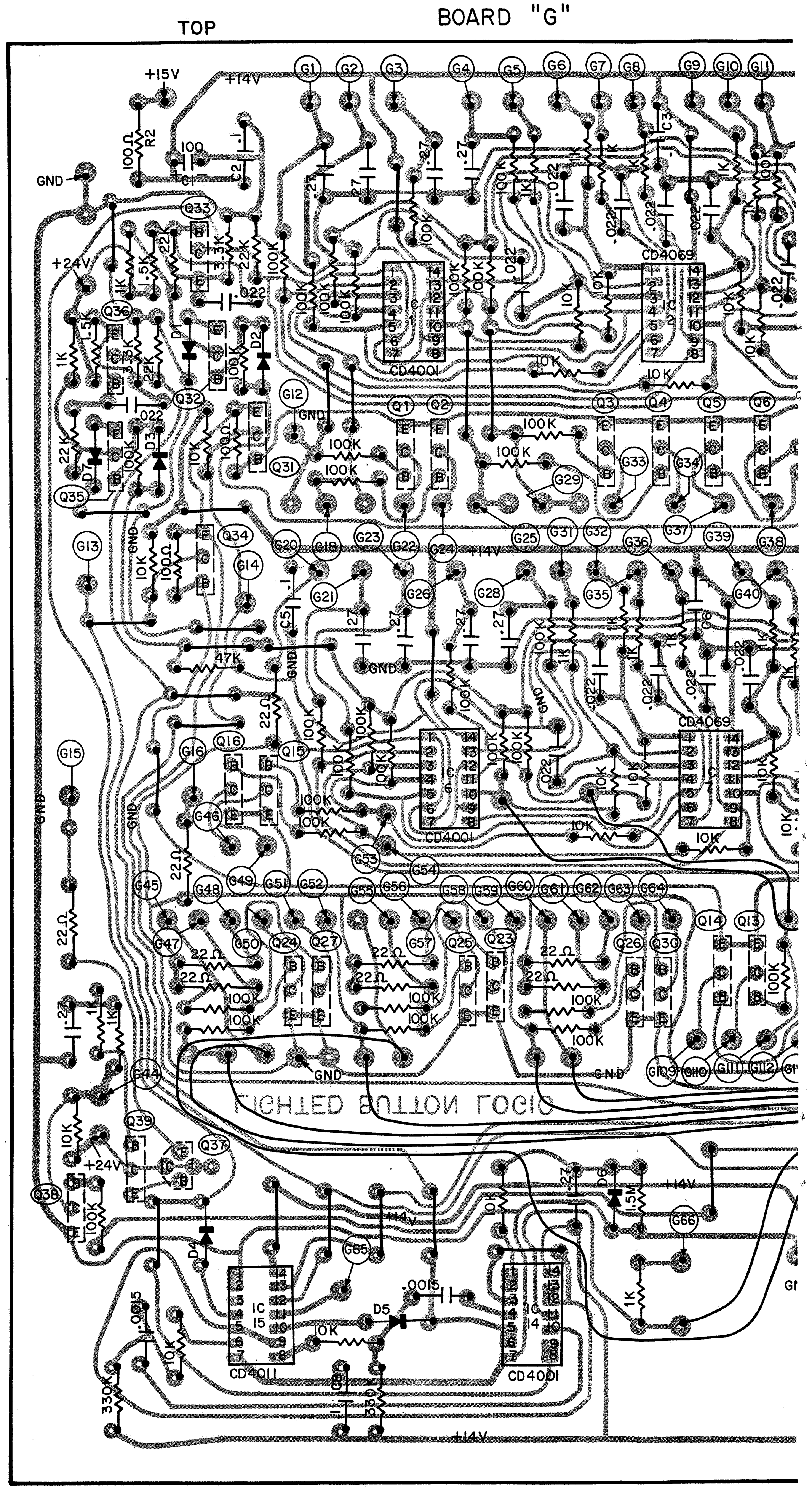
BOARD "L" FLUTE / STRING CHORUS MODULATOR


+15V
CD4027
CD4069
IC6
IC5
IC1
2.2M
220K
D1
D2
D3
D4
GND
LM348
IC2
IC3
IC4
+14.5V
+5V
TOP
SAD-512
SAD-512D
IC7
IC8
IC9
270P
47K
+14.7V
L1
L2
L3
L4
L5
Q1
Q2
Q3
Q4

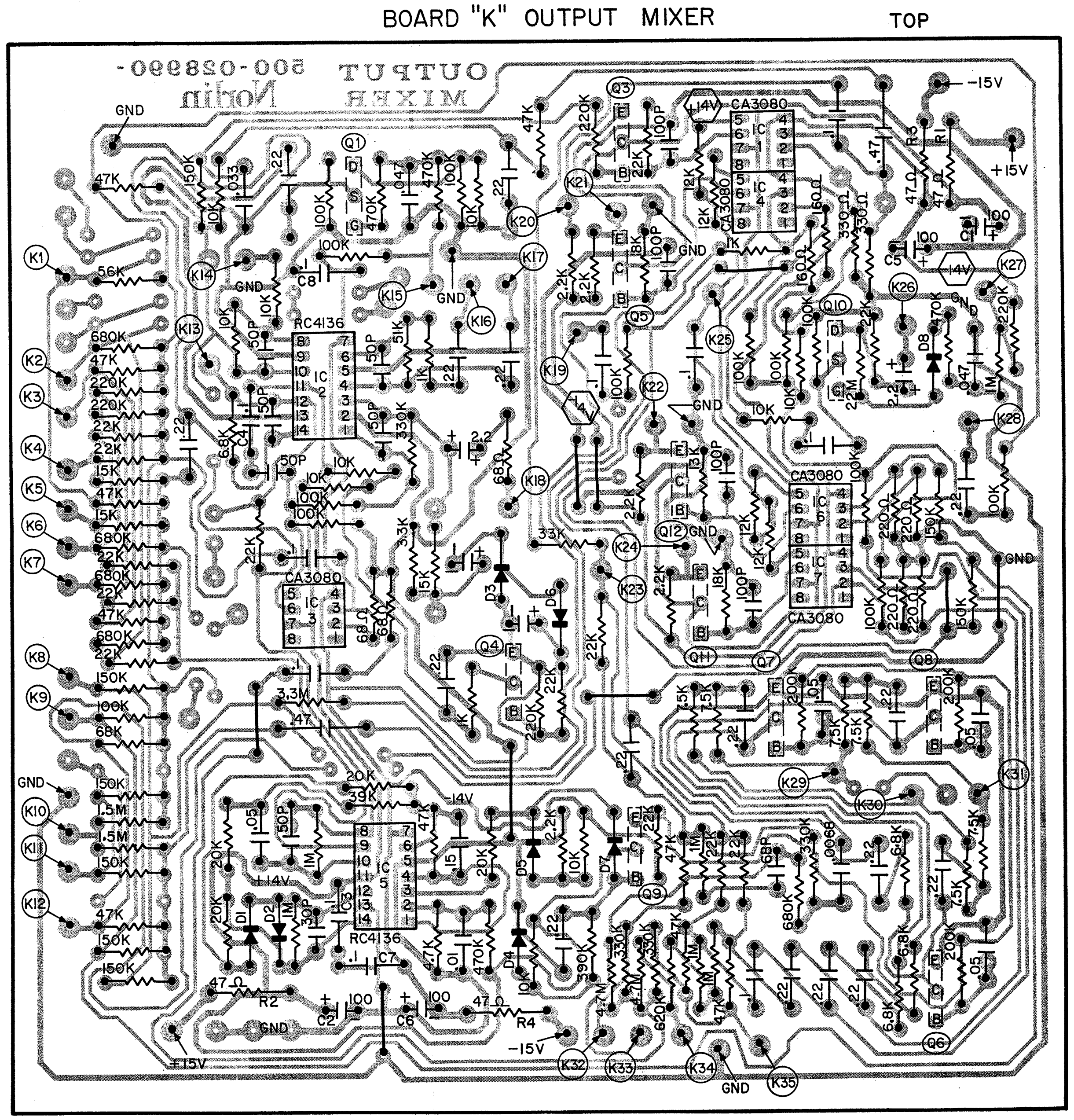
& STRING COLLECTORS


2' Upper Diode Keying Group Inputs
4' Upper Diode Keying Group Inputs
5H
6L
6H
7L
7H
8L
8H
5L
GND
-14V
+14V
100K
2.2
F1
F2
D4
Q37
Q38
p Inputs
2⅔' Audio Keyswitch Group Inputs
UM FLUTE STRING COLLECTORS

BOARD "G"


TOP
+15V
+14V
+24V
GND
G1
G2
G3
G4
G5
G6
G7
G8
G9
G10
G11
G12
G13
G14
G15
G16
CD4069
CD4001
CD4011
IC 15
IC 14
LIGHTED BUTTON LOGIC
D1
D2
D3
D4
D5
D6
Q1
Q2
Q3
Q4
Q5
Q6
Q31
Q32
Q33
Q34
Q35
Q36
Q37
Q38
Q39

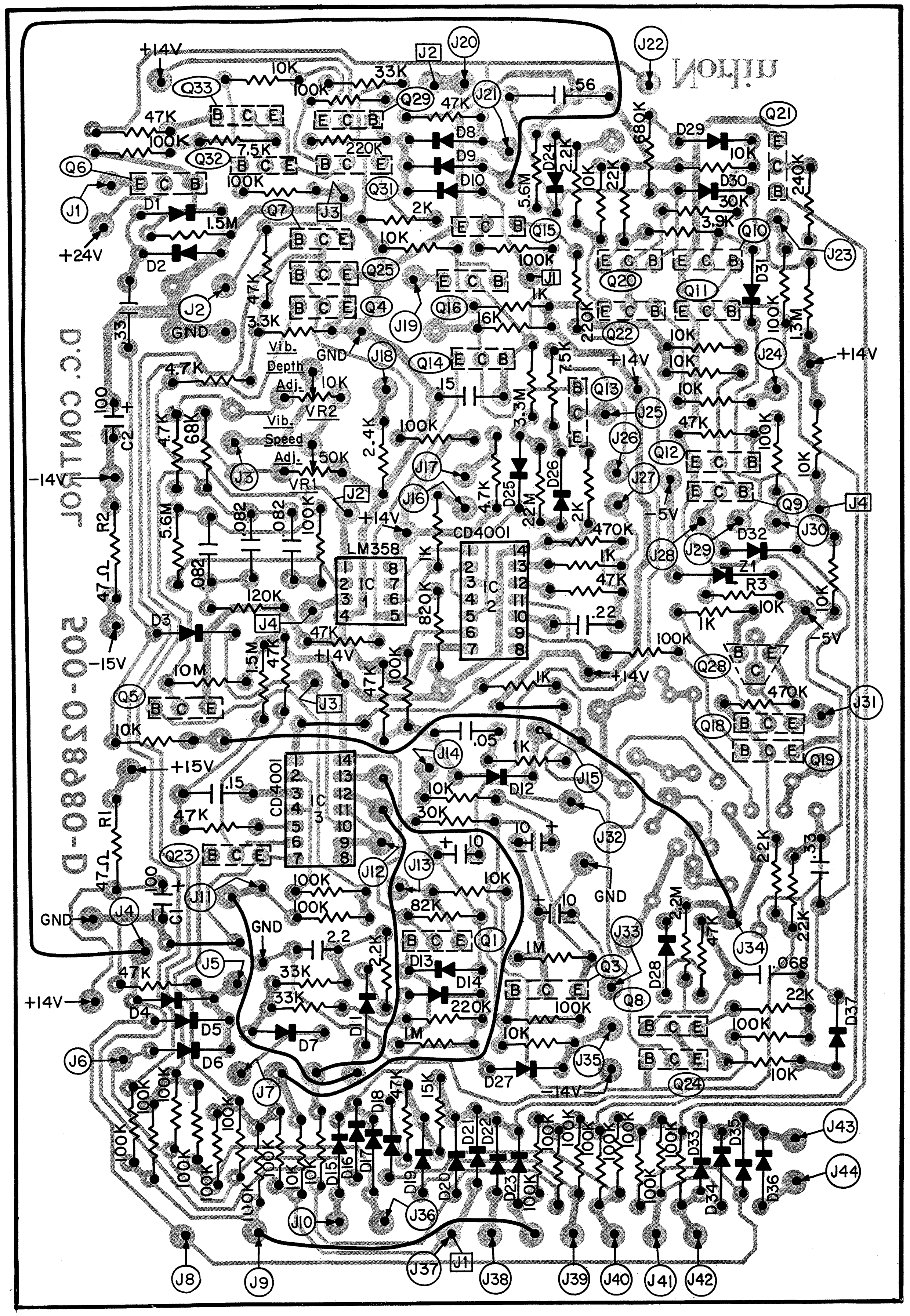
BOARD "K" OUTPUT MIXER


TOP
OUTPUT MIXER
Norlin
500-028990-
GND
-15V
+15V
+14V
CA3080
RC4136
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
K12
K13
K14
K15
K16
K17
K18
K19
K20
K21
K22
K23
K24
K25
K26
K27
K28
K29
K30
K31
K32
K33
K34
K35
Q1
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
R1
R2
R3
R4
C2
C5
C6
C7
C8

TOP

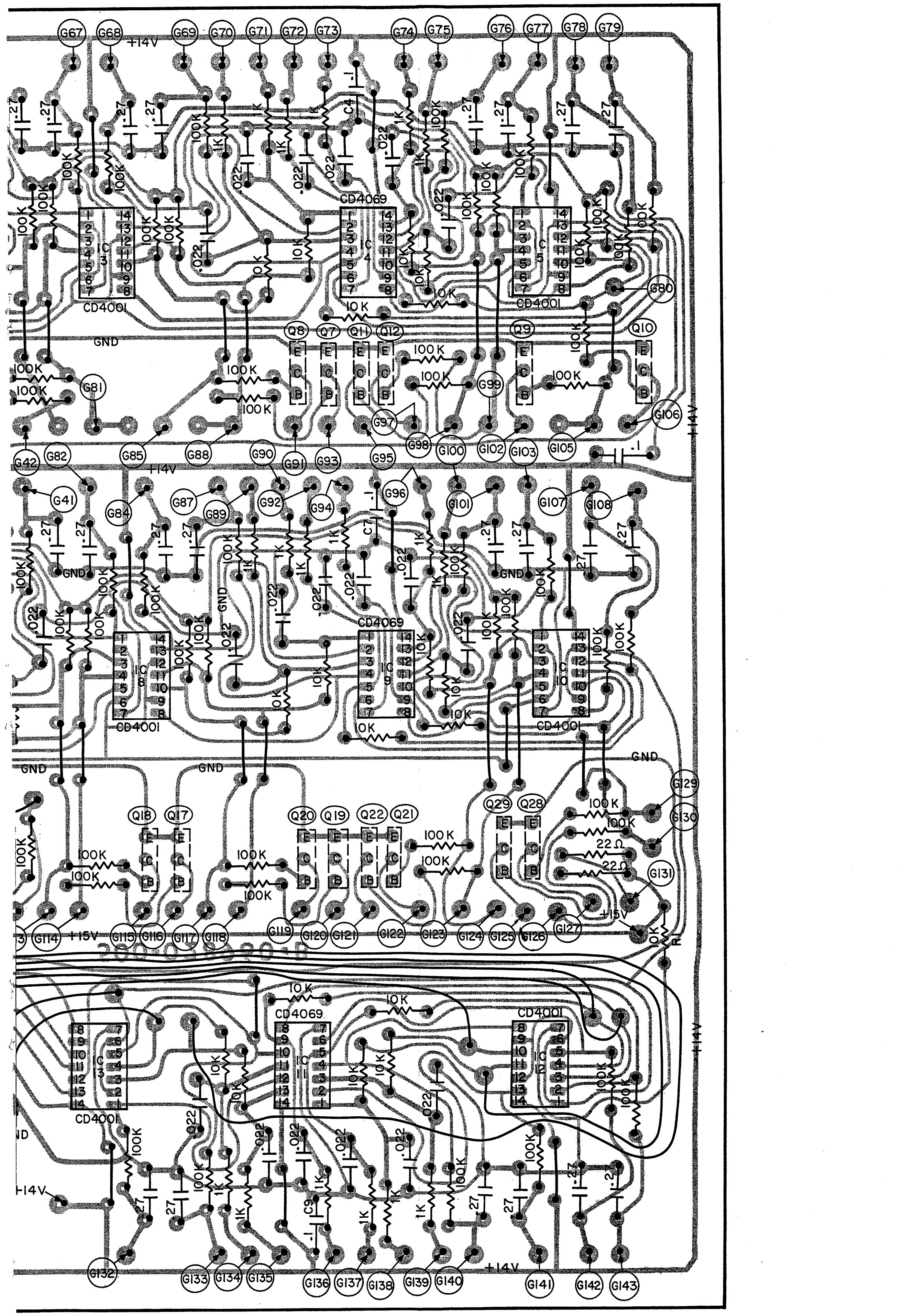
BOARD "J"
D. C. CONTROL

Boxed J No's Indicate On-Board Jumpers


+14V
+24V
-14V
-15V
+15V
GND
Q1
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q28
Q29
Q31
Q32
Q33
J1
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
J12
J13
J14
J15
J16
J17
J18
J19
J20
J21
J22
J23
J24
J25
J26
J27
J28
J29
J30
J31
J32
J33
J34
J35
J36
J37
J38
J39
J40
J41
J42
J43
J44
LM358
CD4001
IC 1
IC 2
IC 3
Vib. Depth Adj.
VR2
Vib. Speed Adj.
VR1
R1
R2
R3
Z1
C1
C2
D.C. CONTROL
500-02880-D
Norlin

LIGHTED BUTTON LOGIC

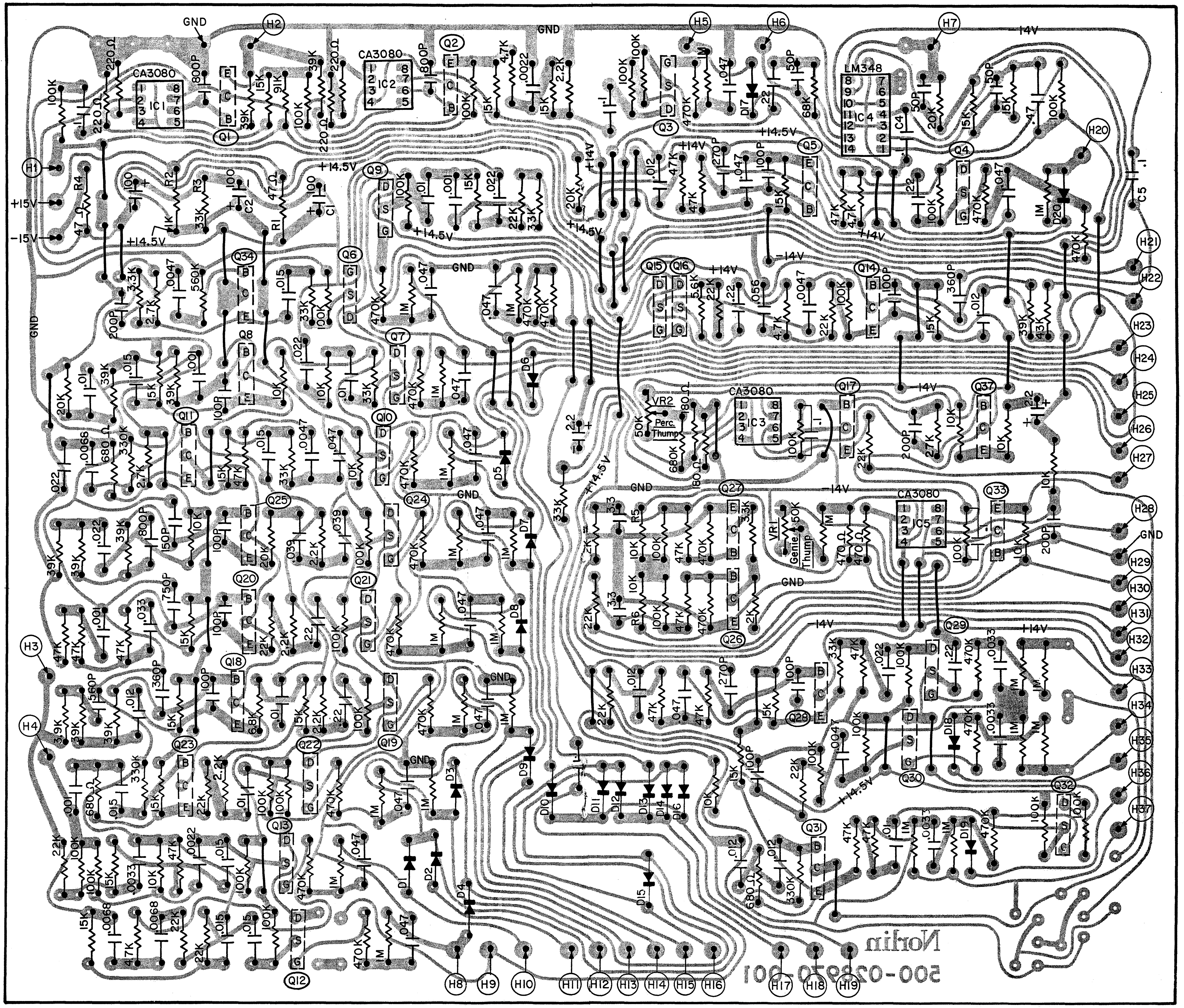
TOP


+14V
+15V
GND
CD4001
CD4069
IC 3
IC 4
IC 5
IC 6
IC 9
IC 10
G41
G42
G67
G68
G69
G70
G71
G72
G73
G74
G75
G76
G77
G78
G79
G80
G81
G82
G84
G85
G87
G88
G89
G90
G91
G92
G93
G94
G95
G96
G97
G98
G99
G100
G101
G102
G103
G105
G106
G107
G108
G114
G115
G116
G117
G118
G119
G120
G121
G122
G123
G124
G125
G126
G127
G129
G130
G131
G132
G133
G134
G135
G136
G137
G138
G139
G140
G141
G142
G143
Q7
Q8
Q9
Q10
Q11
Q12
Q17
Q18
Q19
Q20
Q21
Q22
Q28
Q29
C4
C7
C9

TOP

BOARD "H" UPPER/ LOWER REED/STRING Q.C.

TOP



GND
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
H12
H13
H14
H15
H16
H17
H18
H19
H20
H21
H22
H23
H24
H25
H26
H27
H28
H29
H30
H31
H32
H33
H34
H35
H36
H37
+15V
-15V
+14.5V
+14V
-14V
CA3080
IC1
IC2
IC3
IC5
LM348
IC4
VR1
Genie Thump
VR2
Perc. Thump
Norlin
500-028970-001